U.S. DEPARTMENT OF COMMERCE
National Technical Information Service

PB-257 311

ANIMAL WASTE MANAGEMENT

PROCEEDINGS OF NATIONAL SYMPOSIUM ON ANIMAL WASTE MANAGEMENT HELD AT WARRENTON, VIRGINIA ON SEPTEMBER 28-30, 1971

COUNCIL OF STATE GOVERNMENTS

PREPARED FOR
ENVIRONMENTAL PROTECTION AGENCY

1971

BIBLIOGRAPHIC DATA SHEET

1. Report No. LCCCN-70-188504

2.

3. Recipient's Accession No. PB-257 311

4. Title and Subtitle
Animal Waste Management. Proceedings of National Symposium on Animal Waste Management Held at Warrenton, Virginia on September 28-30, 1971.

5. Report Date 1971

6.

7. Author(s)

8. Performing Organization Rept. No.

9. Performing Organization Name and Address
Council of State Governments
Washington, D. C.

10. Project/Task/Work Unit No.

11. Contract/Grant No.

12. Sponsoring Organization Name and Address
Environmental Protection Agency
Washington, D. C.

13. Type of Report & Period Covered

14.

15. Supplementary Notes

16. Abstracts Contents: Improved control of animal wastes; Animal waste management and the environment; Summary of existing state laws; State regulations pertaining to livestock feedlot design and management; Developing new state legislation/model state statute for animal waste control; The Minnesota scene: livestock feedlot, waste control, progress-problems; State of Oklahoma activities in animal waste management; Proposed animal waste pollution control legislation in North Carolina; State of Virginia activities in animal waste management; Effluent discharge guidelines and animal waste management technology; Status of dairy cattle waste treatment and management research; Cattle feedlot pollution; Poultry waste management; The handling and treatment of swine wastes; Recycling of animal wastes; Regulatory aspects of recycled livestock and poultry wastes; Water pollution and the farmer; U.S.D.A. Technical and Financial assistance programs; Providing technical and financial assistance to farmers for animal waste disposal systems; Technical and financial assistance for the control of animal wastes; Small Business Administration programs to provide financial and technical assistance to small firms in solving problems relative to animal waste disposal; Financial assistance for the construction and improvement of irrigation systems; The Lake Mendota watershed project; The role of extension in pollution abatement in Virginia; Communication is the key to successful action.

17. Key Words and Document Analysis. 17a. Descriptors

*Livestock
*Agricultural wastes
*Pollution
*Meetings
Solid waste disposal
Water quality management
Odors
Water pollution abatement
Law(Jurisprudence)
State government

Poultry
Design
Oklahoma
North Carolina
Virginia
Nebraska
Dairy Cattle
Swine
Minnesota
Recommendations

17b. Identifiers/Open-Ended Terms

*Animal wastes
Feedlot wastes

17c. COSATI Field Group 13B, 2C, 2E

18. Availability Statement
National Technical Information Service
Springfield, VA 22161

19. Security Class (This Report) UNCLASSIFIED

20. Security Class (This Page) UNCLASSIFIED

21. No. of Pages 185

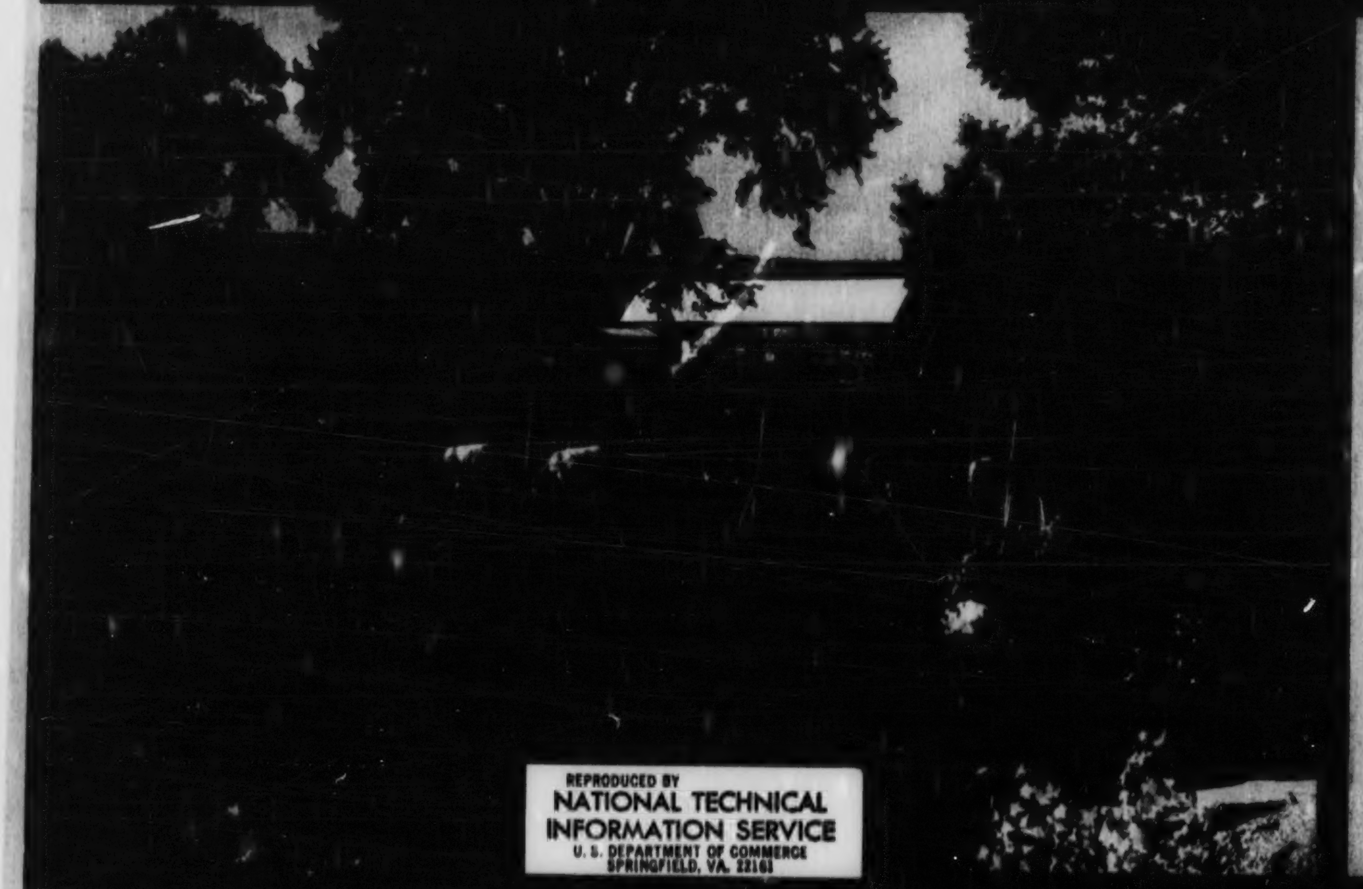
22. Price PC$7.50/MF$2.25

FORM NTIS-35 (REV. 10-73) ENDORSED BY ANSI AND UNESCO. THIS FORM MAY BE REPRODUCED USCOMM-DC 8265-P74

PB 257 311

257079

ANIMAL WASTE MANAGEMENT



REPRODUCED BY
NATIONAL TECHNICAL
INFORMATION SERVICE
U. S. DEPARTMENT OF COMMERCE
SPRINGFIELD, VA. 22161

Proceedings of National Symposium on Animal Waste Management

ANIMAL
WASTE
MANAGEMENT

Proceedings of
National Symposium on
Animal Waste Management

Sponsored by: The Council of State Governments
The Environmental Protection Agency
The National Association of State
Departments of Agriculture
The National Association of State Universities
and Land Grant Colleges
The United States Department of Agriculture

SEPTEMBER 28-30, 1971 • THE AIRLIE HOUSE, WARRENTON, VIRGINIA

The opinions expressed herein are solely that of the authors and do not necessarily represent official policies of the representative organizations.

Printed in the United States of America

Library of Congress Catalog No. 70-188504

Council of State Governments
1735 DeSales Street, N.W.
Washington, D.C. 20036

CONTENTS

Foreword 1
Edward H. Hansen, Office of the Secretary of Agriculture

Introduction 3
Hon. Philip Alampi, New Jersey Department of Agriculture

Improved Control of Animal Wastes 7
Hon. J. Phil Campbell, Under Secretary of Agriculture

Animal Waste Management and the Environment 11
David D. Dominick, Environmental Protection Agency

STATE ACTIVITIES IN ANIMAL WASTE MANAGEMENT

Summary of Existing State Laws 17
William Stanwood Cath, National Association of State Departments of Agriculture

State Regulations Pertaining to Livestock Feedlot Design and Management 19
William F. Schwiesow, U.S. Department of Agriculture

Developing New State Legislation/Model State Statute for Animal Waste Control 27
R. Deane Conrad, Council of State Governments

The Minnesota Scene: Livestock Feedlot, Waste Control, Progress—Problems 33
Rollin M. Dennistoun, Minnesota Department of Agriculture

State of Oklahoma Activities in Animal Waste Management 37
Billy Ray Gowdy, Oklahoma Board of Agriculture

Proposed Animal Waste Pollution Control Legislation in North Carolina 41
Milton S. Heath, Jr., University of North Carolina

State of Virginia Activities in Animal Waste Management 45
Larry G. Lawson, State of Virginia Water Control Board

Discussion 49

Luncheon Address 53
The Hon. J. James Exon, Governor, State of Nebraska

SOLVING the PROBLEM: A PANEL DISCUSSION

Moderator: *Norman Berg;* **Panelists:** *Lloyd Essick, Virgil D. Beougher, Bobby C. Heitschmidt, Virgil P. Carlson, L. Dean Strowig* 57

RESEARCH and TECHNOLOGY

Effluent Discharge Guidelines and Animal Waste Management Technology 69
Harold Bernard, Jeffery Denit and Donald Anderson, Environmental Protection Agency

Status of Dairy Cattle Waste Treatment and Management Research 85
A. C. Dale, Purdue University

Cattle Feedlot Pollution 97
Frank G. Viets, Jr., Fort Collins, Colorado

Poultry Waste Management 107
Raymond C. Loehr, Cornell University

The Handling and Treatment of Swine Wastes 111
Arthur J. Muehling, University of Illinois

Recycling of Animal Wastes 121
Robert G. Yeck and Paul E. Schleusener, U.S. Department of Agriculture

Regulatory Aspects of Recycled Livestock and Poultry Wastes 129
Jack C. Taylor, Federal Drug Administration

Water Pollution and the Farmer 133
The Hon. Fred Schwengel, U.S. Congressman, State of Iowa

GOVERNMENT TECHNICAL and FINANCIAL ASSISTANCE

U.S.D.A. Technical and Financial Assistance Programs 139
T. C. Byerly, U.S. Department of Agriculture

Providing Technical and Financial Assistance to Farmers for Animal Waste Disposal Systems 143
Gene L. Swackhamer, Farm Credit Administration

Technical and Financial Assistance for the Control of Animal Wastes 147
Kenneth M. Mackenthun, Environmental Protection Agency

Small Business Administration Programs to Provide Financial and Technical Assistance to Small Firms in Solving Problems Relative to Animal Waste Disposal 153
Arthur E. Armstrong, Small Business Administration

Financial Assistance for the Construction and Improvement of Irrigation Systems 154
Y. C. Yates, State of New Mexico

Discussion 157

TELLING the STORY

The Lake Mendota Watershed Project 163
Donald G. Last, The University of Wisconsin

The Role of Extension in Pollution Abatement in Virginia 169
R. Lewis Wesley, Virginia Polytechnic Institute and State University

Communication is the Key to Successful Action 173
Earl W. McMunn, The Ohio Farmer

REPORTS and RECOMMENDATIONS

Working Groups Reports and Recommendations 179

Recommendations of National Milk Producers Federation 187

REACTIONS 189
Ned B. Bayley, U.S. Department of Agriculture; Will Erwin, Environmental Protection Agency; Hon. Don W. Moos, State of Washington Department of Agriculture; Hon. John C. Crofoot, State Senator, Kansas; Glenn H. Beck, Kansas State University

LIST of PARTICIPANTS 197

FOREWORD

EDWARD H. HANSEN

Acting Assistant to the Secretary
Office of the Secretary of Agriculture

This proceeding represents a record of the first meeting that was ever co-sponsored by the U.S. Department of Agriculture, Environmental Protection Agency, Council of State Governments, National Association of State Universities and Land Grant Colleges, and National Association of State Departments of Agriculture. The purpose: to focus on a problem with which they all have an interest and responsibility. There is no doubt of the public concern in a cleaner environment, including clean streams and waterways. At the same time, food requirements increase with the growing population and this has resulted in heavier concentration of livestock and poultry production which are contributing to the pollution of our streams. Thus, it is that animal waste management becomes a matter of public concern. Under such circumstances the farmer and rancher who raises livestock and poultry are subjected to both Federal and State laws and regulations. When laws are passed and enforced, farmers and ranchers are often required to make changes in traditional operating procedures. They then look to the public and private research agencies to develop new technology that will allow them to conduct their livestock and poultry operations in a manner that will minimize pollution of the environment and yet allow them a fair return on their investment. Implementation of new technology to reduce pollution often requires a heavy immediate expenditure by farmers and ranchers. Those at the Symposium considered various ways that financial assistance might be made available to farmers and ranchers to help assure the earliest possible application of new pollution abatement techniques. There have been numerous research conferences on animal waste management, but this meeting was not a research conference—even though we were favored in having top researchers from throughout the U.S. present with us.

This symposium provided an opportunity to have leading Federal and State legislators, regulators, government and private researchers, farm and commodity organization representatives and farmers-ranchers meet together and share experiences, knowledge, and concerns and hopefully to come up with recommendations that will help assure attainment of our environmental objectives in a manner that will give due consideration to the problems faced by farmers and ranchers in making changes in their operations.

INTRODUCTION

PHILLIP ALAMPI

Secretary of Agriculture
State of New Jersey

This Symposium on Animal Waste Management is another milestone towards developing solutions and action programs relating to the problems of improving the management, disposal and recycling of agricultural waste. I deem it a particular privilege and a high honor to have been selected to open this conference and set forth a few of the key challenges that I see before us.

A conference on "Agricultural Waste in an Urban Environment" was held in Atlantic City, New Jersey, September 14-17, 1970. That conference was sponsored by the New Jersey Animal Waste Disposal Task Force in cooperation with the states of New York, Pennsylvania and Delaware. The highlights of the conference are set forth in published proceedings in some detail. With approximately 230 delegates from 26 states, Puerto Rico, Guam and Washington, D. C., in attendance, a number of recommendations were made that were aimed at developing action programs for solving agricultural waste disposal and recycling problems, particularly in urban areas.

This conference also recommended through a resolution directed to the appropriate state and federal officials that the meeting we are attending today be called "at the earliest possible date, such conference to involve the best talents of government officials at all levels, as well as those engaged in land use planning, research, teaching, extension, regulatory work, agricultural production and related industries." In order to reach this resolution, the delegates mentioned several "whereases." They were:

"WHEREAS, more adequate means of effectively disposing of and utilizing agricultural waste has now become essential to the future expansion of agriculture in the United States; and

WHEREAS, many agricultural enterprises across the nation are now being closed down because of inadequate technology to deal with agricultural pollution abatement problems; and

WHEREAS, the resources that are now available are not being used in proportion to the magnitude of the agricultural waste problem; and

WHEREAS, the Federal Solid Waste Disposal Act of 1965 authorized nearly $80 million of which Congress appropriated $64 million with only $2,250,000 spent on agricultural waste projects through 1970; and

WHEREAS, there is an urgent national need for a coordinated effort of all groups concerned to arrive at solutions to the problems of agricultural waste disposal and utilization as quickly as possible."

Incidentally, I am proud to say that the Atlantic City conference grew out of an organization originating from within the New Jersey

Preceding page blank

Department of Agriculture. Four years ago the Department, in cooperation with the New Jersey Department of Health, The College of Agriculture and Environmental Science—Rutgers, and municipal, county and farm organizations, established the New Jersey Animal Waste Disposal Task Force. The Task Force is comprised of 23 local, state and federal representatives, public and private, from various fields of interest, who are concerned with the disposal of animal waste in all of its ramifications.

The Task Force, through its committees on producer guidelines, legislation, research and information, has made good progress. Realizing, however, that what we do in New Jersey is really a forerunner of what is eventually to come all over the nation, the Task Force came up with the idea of holding the Atlantic City conference.

Its members felt that New Jersey's next door neighbors would be interested in joining in. This was immediately instigated and to our delight New York, Pennsylvania and Delaware joined as our cooperators.

I see many distinguished leaders from State Departments of Agriculture, the United States Department of Agriculture, the Environmental Protection Agency, industry, research organizations, the Council of State Governments, the National Association of State Universities and Land Grant Colleges and other invited guests at Airlie House. I am confident that we can leave the meeting having agreed upon certain programs that can be put into action at an early date.

Obviously, we cannot move forward with the implementation of many of our waste recycling systems that have been proposed without certain clearances from regulatory agencies at the local, state and federal level. It should not only be the role of regulatory agencies to "regulate" but at the same time they should provide assistance and guidance. This should include procedures that are workable and practical and would tend to reduce pollution emanating from agricultural waste. Of course, this is a big task. On a tonnage basis agricultural waste in all of its ramifications represents approximately one half of the total of 4.3 billion tons of solid waste produced annually in the United States. It is estimated that more than 5,000 tons of such waste are produced each day in a small state like New Jersey. This figure becomes even more impressive when it is considered that New Jersey is the most highly urbanized state in the nation. Likewise, I feel sure that similar problems exist in many of the other highly urbanized areas represented here today.

The agricultural industry of this country continues in a very tough cost-price squeeze. Through more efficient recycling of agricultural waste we can greatly improve the economic position of the farmer and minimize pollution problems that affect all of our citizens.

As an example, I would suggest that one of the major thrusts be directed towards developing manufacturing guidelines for the processing, upgrading and supplementation of all types of biodegradable agricultural waste, including animal waste, into a product suitable for feeding to livestock and poultry. As our livestock and poultry operations get fewer in number and larger in size greater concentrations of waste will accumulate at any given point. Quite often this is in the proximity of neighboring urban dwellers. We must devise processing systems that can take animal waste and other biodegradable agricultural waste products and process them in such a manner that they can be completely reused as animal and poultry feed. We have established such guidelines for products such as the manufacturing of fish meal, tankage, etc., in the past. Of course, any such product must be manufactured in such a way that it does not transmit residues, diseases or pathogens that would be harmful to animals or poultry or the consuming public.

Recently many technological breakthroughs have been made in the areas of recycling agricultural waste including dehydration and bacteriological fermentation. There are experts here today that can speak specifically to these processes. The big problem in converting livestock and poultry waste into an edible feed is the lack of approval by the Food and Drug Administration of the process. If there be missing gaps in our research and answers to questions that are not available, then let us determine what these are and establish the research programs to provide this information as quickly as possible. If research has shown to date that products can be manufactured that would be wholesome to use, then the Food and Drug Administration and any other regulatory agencies that are necessary should give their immediate approval to the process. And time is running out on us! It is only when this is accomplished that the entrepreneurs in our free enterprise system will recognize the potential market for systems to carry out the processes for waste recycling. Once the guidelines are established, the systems will be manufactured and sold to those who can put them to use, thus improving the economic position of the livestock and poultry producer as well as reducing the problems resulting from pollution abatement.

The way for livestock and poultry producers in urbanized areas like New Jersey to remain competitive is to recycle this vast volume of agricultural waste at their back doors. In such urbanized areas, where land and labor costs are so great, producers find it increasingly difficult to compete with less urbanized areas of the country. To recycle waste into a useful and nutritionally complete feed supply will help them offset the advantages enjoyed by such competitors in less urbanized areas where land is cheaper and adequate grain supplies can be produced for livestock and poultry feeding.

I would like to congratulate the Secretary of Agriculture Clifford M. Hardin, the Administrator of the Environmental Protection Agency William D. Ruckelshaus and their colleagues in the Council of State Governments, the National Association of State Departments of Agriculture and the National Association of State Universities and Land Grant Colleges for their leadership in establishing this conference.

As I said earlier, I am sure it will prove to be a milestone in establishing those necessary breakthroughs that will move us towards solving the agricultural waste problems we face and minimize the time that we might otherwise have spent in simply talking about it.

IMPROVED CONTROL OF ANIMAL WASTES

J. PHIL CAMPBELL

Under Secretary of Agriculture

I am confident that the environmental problems caused by rapidly increasing quantities of animal wastes can and will be solved. But, it will take coordinated efforts by producers, agri-business, and local, State, and Federal Governments, as well as research institutions.

Since all these entities are involved, it is appropriate that a broadly based group such as this seminar discuss how their respective roles fit into an effective management program for animal waste.

The management of animal waste requires immediate attention. Animal wastes in this country are one of the significant sources of waste in our agricultural-industrial-commercial-domestic complex. Fortunately, most of this is presently disposed of on the land and does not constitute an environmental pollution threat.

The problem stems from the enormous expansion in American demand for livestock and poultry products in recent years, and the increasingly concentrated nature of livestock and poultry production to meet this demand. We must be aware, too, that this demand is going to increase. Diets are being continually upgraded and our school breakfast and lunch and food stamp programs have contributed to this upgrading.

As foreign countries raise their dietary levels, they may turn to the U.S. even more as a source of supply thereby further increasing demands for meats and poultry.

Units marketing from 300 to 1,500 hogs per year are not uncommon. Roughly one-fourth of the broiler enterprises have 100,000 broilers or more and several thousand egg producing enterprises have from 10,000 to more than 100,000 chickens. In modern mechanized dairy operations, milk cow populations of 100 or more are rather common.

A rapidly increasing proportion of all cattle is now in concentrated beef and dairy operations. Eighty to 90 percent of swine, poultry, and broilers are raised in concentrated areas. Where this production is in close proximity to urban, recreational, and other areas heavily used by people, problems of odors, insects, rodents, and dust can arise. Stream pollution can be a problem even in more remote areas.

While these concentrated operations provide more, better, and cheaper meat, milk, and eggs, they result in greater concentration of wastes. Yet, we must also recognize that these enterprises provide many opportunities for rural development, including market outlets for feed grains and jobs which stimulate growth of rural communities.

Modern farming techniques complicate animal waste disposal. The traditional method of disposing of animal wastes was to return them to the land as a valuable asset in providing soil fertility. Today, however, it is cheaper

Preceding page blank

to buy commercial fertilizer than to haul natural fertilizer from a big feedlot and apply it to the land.

Also, the bigger and more concentrated our livestock, poultry, and egg operations become, the farther they are likely to be from sufficient land suitable for waste disposal.

Other complicating factors include the reduced availability and higher cost of labor for waste disposal, the relatively narrow profit margins under which livestock and poultry enterprises operate, increased property taxes on structural improvements, and the uncertainty of agricultural markets.

The estimated costs for installing diversion, containment, and other facilities for nonpolluting livestock waste management could amount to almost $3 billion. It is unrealistic to expect producers to meet all of this heavy expense out of their own pockets. Public financial and technical assistance must be provided, particularly the development of needed technology.

If livestock and poultry enterprises are saddled with the increased costs of meeting environmental quality standards in disposing of wastes, a great many will be forced out of business. The result will be smaller total output of meat, milk, and eggs along with considerably higher prices to consumers.

Present technology is devoted to holding back or diverting waste materials until they can be returned to the land. Most research emphasis has been on reducing stream pollution from beef cattle feedlot runoff. Diversion terraces, lagoons, and detention ponds have proved satisfactory for many beef feedlots.

However, while land recycling remains the major means of disposal, it is not feasible for some livestock enterprises and is unusually costly for others. Moreover, State and Federal quality standards cannot always be met economically merely by preventing wastes or effluents from entering streams, ponds, lakes, or ground water. Alternative methods of disposal are needed and must be developed.

Among the possibilities are recycling of animal waste for use as livestock feed with full assurance that the end products pose no health or residue problems. This requires, among other things, additional research on the residues of drugs in wastes and the effect of these residues on the recycled products. Another possibility is distillation to produce fuel oil. Still another possibility for disposal is incineration. The means are at hand to accomplish this with little air pollution, but the process is expensive.

Actually, technology in controlling air pollution from animal production activities is in its infancy. Many livestock producers have been able to avoid water pollution but lack the technology for overcoming offensive odors. Research is needed to develop economical and acceptable methods for avoiding the formation of odors or reducing their intensity.

A successful attack on the problem of animal wastes requires cooperation among USDA, the Environmental Protection Agency, State and local agencies, and private enterprises. Animal waste management must be integrated and coordinated with a total national pollution abatement plan.

The USDA now provides some financial assistance to farmers through the Rural Environmental Assistance Program which places a high priority on public benefits. This program, however, is not available to feedlot operators unless the feedlot is part of a farm which is able to qualify for participation in REAP.

Basic practices for waste management systems must be developed with local, State, and Federal health and regulatory agencies to insure compliance with health and water quality standards.

Each waste management system must be tailored to the needs of the individual farmer or rancher within the capability of soils and plant cover. Soil varies greatly in its ability to recycle waste. Wet or dry climate, storm intensity, and topography must also be considered.

As much individual ingenuity as possible should be encouraged. Some operators of feedlots have arranged to buy feed from neighboring farmers who deliver the feed and then haul away animal wastes for disposal on their own lands. I know that broiler producers in Georgia have demonstrated similar ingenuity in dealing with the problem of waste disposal.

The prevention of agricultural pollution must be based on a technology that has been thoroughly tested and proved as (1) economically feasible for producers, (2) safe with reference to the quality of products, and (3) protective of the public's rights to a clean environment.

The USDA recently re-emphasized its commitment to helping clean up the environment through a new program known as "Environmental Thrust." This is a nationwide citizens' campaign in which USDA officials and employees in more than 3,000 counties will give guidance and support to volunteer community leaders and clubs concerned with enhancing the quality of life.

With 80 percent of our nation's land available for farming and forestry, agriculture's obligation in improving our environment is great. This is why the solution to this problem definitely requires a close working relationship between Federal and State legislative bodies as well as between Federal and State executive agencies and research facilities.

Laws and regulations must recognize the technological status of the problem being attacked. While laws and regulations can hasten the development of new and improved practices, impossible burdens should not be placed on target groups, such as farmers and ranchers, to reach a point of perfection that is unattainable.

Just as other industries have been given time to apply new technology, or carry forward research to reduce environmental damage, so the farmer must be given consideration in meeting the new environmental responsibilities being placed on him.

ANIMAL WASTE MANAGEMENT AND THE ENVIRONMENT

DAVID D. DOMINICK

Assistant Administrator, Office of Categorical Programs
Environmental Protection Agency

INTRODUCTION

Growing up in Cody, there was a fellow who was very important in my life. His name was Art Holman. People in town called him Bonehead because he was the one person in this little town of five thousand that was perhaps stupid enough, or perhaps courageous enough to bid on the mail contract going into our little valley of Sunlight, about 50 miles out of town. Sunlight was in the pocket of the mountains. They named it that because many times of the year the sun was the only thing that could get in there.

Bonehead Holman had the mail route, mail would go in once a week and he would start out on Wednesday. If he was lucky he would get in there on Thursday in the winter time. If he wasn't lucky he would get back to town by the time he was to pick up the next sack and start all over again. At the age of 76, I was fortunate enough to have been with him one winter and we ran wild horses together. This was before they passed the federal law. Federal law or not, we ran them in the classic-old-time-manner with a couple of horses, pretty well bred horses, and we had them grained up so they were plenty hot. And we would run these wild horses in a circle. Bonehead would take them for the first 50 miles, I would be on a fresh horse and pick them up for the next 50, and we would run them for many weeks at a time until we could finally corral them. And he would go for many weeks at a time without saying much. One story that he told me and my brother up at our ranch was a great one. He told about when he was riding with Buffalo Bill in Buffalo Bill's Wild West Show back in the early part of this century. He was 16 years old when he started and was 19 when he quit. He was one of the only two fellows who stayed with the show the whole time that didn't get busted up. He told about the time he was riding a bucking horse, and in those days they had to saddle their horses right in the middle of the arena, put a blind on them, jump on, get set as well as they could and pull the blind and away they went. And the horse he was riding that day was a bad one. And they were riding in front of the Crown Prince and Princess of Austria and Buffalo Bill was sitting up in the stands with the Crown Prince and Princess and there were two fences separating the arena from the box where the Prince and Princess were sitting and Buffalo Bill was next to them. And this bucking horse that Art was on, Art Holman went across that first fence, bucking hard, bucking high and started up that second fence and fell back. And as he fell back, Art jumped off, he was

Preceding page blank

quick as a cat, and he pulled the [illegible] rein over across that horse's head and he [illegible] his head and was sitting there and he listened and he heard Buffalo Bill saying to the Crown Prince and Princess, "Now, there is nothing to be afraid of because these cowboys have these horses under perfect control at all times." And Art was sitting there in front of the fire at the ranch and telling us this story and it seemed like five minutes passed and then he finally looked up again and he said, "I had him under perfect control all right, because I was sitting on his head."

Well, I think that tells us something about this whole issue that we're confronted with here now and in the next decade . . . the issue of agricultural waste.

"Control of Ag-Related Pollution" Report

In a report to the President in 1969, entitled "Control of Agriculture-Related Pollution," prepared by the Department of Agriculture and the Office of Science and Technology, it was indicated that animal wastes resulting from confined livestock feeding operations created one of the country's three main agricultural pollution problems. The other two pollution problems related to agriculture are caused by irrigation return flows and sediment-laden runoff.

Pollution resulting from improper or inadequate animal waste management is not limited in scope. It affects the total environment—air, land, and water. Water pollution results when water infiltrates a manure mass and carries dissolved and suspended materials to surface waters causing fish kills and damaging eutrophy of the receiving waters. Livestock and poultry operations can create air pollution problems involving odors, dust, and windborne pesticides. Odors probably bring more pressure to bear on agricultural enterprises than any other type of pollution because they are easily detected by the ordinary citizen. Land pollution results if the soil is overloaded with animal wastes. Finally, flies and other insects, which are attracted to animal waste, can become nuisances and public health hazards.

In addition to these detrimental aspects, improper waste management is inefficient, because it negates the opportunity to use the wastes as a soil amendment.

Animal wastes have become a pollution source for the same basic reason that other forms of environmental degradation have arisen, namely an increasingly concentrated and growing population. Animal waste related water and air pollution problems have been caused primarily by the rapid growth of large, confined animal feeding operations during the past decade. This feeding trend will continue because the increased population will create an increase both in per capita consumption of meat and in the meat yields from intensified feeding operations. Hence, the thrust of the pollution problem of animal waste management is in the confined feeding area.

In the past, such pollution caused little concern. However, water pollution could have been reduced if locations had been carefully selected, if runoff had been kept out of streams, and if enough land had been available for disposing of liquid and solid wastes. Rectifying these mistakes is a costly and difficult process. Even without mistakes, proper animal waste management poses a challenge because technology has not kept pace with the growing livestock industry.

Because of the surging public interest in environmental protection, much of it long overdue, government at all levels has been pressing the agriculture industry to reorder its priorities to protect the environment, not only to raise productivity. Regulatory controls over feedlots have, therefore, multiplied during the past 10 years and will continue to do so for the foreseeable future.

Inadequate Statutes

Most States have long-standing public health and nuisance laws that, theoretically, govern livestock and poultry operations with regard to flies and other disease vectors, odors, and dust. However, these statutes do not address the whole spectrum of air, water, and land pollution caused by feedlots.

The Federal Water Quality Act of 1965 required the States to establish water quality standards. As a result, all the States now have water quality standards that, along with plans for implementation and enforcement, are being approved by the Federal Government. With respect to confined animal feeding operations, these standards mean that runoff must be collected and treated to a degree consistent with water quality standards assigned to the relevant stream segment. State water pollution control agencies monitor and regulate waste discharges and runoff and can take legal action against violators. Hence, there is at least one agency in each State that now regulates to some degree the operation of feedlots.

The term "feedlots" is not limited to beef animals, but rather encompasses a broader range of farm animals, such as dairy cows, broiler chickens, laying hens, turkeys, hogs, feeder pigs, sheep, lambs, and ducks.

The Environmental Protection Agency recently surveyed the States to identify the agencies that directly or indirectly regulate confined animal feeding facilities. Eight States now have statutes and regulations requiring certain feedlot operators to register with the State. These regulations:

- Define terms used in confined feeding operations;
- Outline when registration is required and what information must be supplied;
- Establish minimum standards for waste management systems; and
- Delineate penalties.

Eighteen States are actively pushing for the adoption of specific regulations for confined feeding areas.

In 21 States, some form of approval must be obtained before operations can begin. However, the remaining 29 States do not require approval—provided that animal wastes, treated effluents, and runoff will not leave the site except under catastrophic rainfall conditions.

Even if construction operation permits are not needed, many States require approval of waste treatment facilities from which discharges will emanate. A prospective feedlot operator would thus be wise to contact both the State's water pollution control agency and Department of Agriculture before engaging in any feedlot activities.

The Refuse Act of 1899

More recently, the Refuse Act of 1899 has been used as an additional means for controlling pollution.

Mr. William Ruckelshaus, Administrator of EPA, announced in May that the provisions of the Permit Program authorized under the Refuse Act had been extended to cover some confined feeding operations. The Permit Program, administered jointly by EPA and the Corps of Engineers, was developed to control the types and amounts of wastes that industry may discharge into water courses. The program applies to both confined livestock and poultry feeding operations, but because of administrative constraints at present, it covers only feeding lots with 1,000 animal units or more. Other limitations are also spelled out. Extending the permit program to feedlot operations is a forward step in stemming agricultural pollution.

Recognizing that the States have the primary right and responsibility to control water pollution, the Permit Program allows them to certify or comment on discharges affecting water quality. This part of the program implements the State certification requirements of Section 21(b) of the Federal Water Pollution Control Act. EPA's role is to advise the Corps of Engineers on the impact of the proposed discharge. EPA's recommendations will, in general, have great weight in the State certification process. EPA will maintain constant communication with each State, work our procedures to ensure that the Permit Program is compatible with theirs, support those whose resources are limited, and attempt to resolve differences.

The Solid Waste Disposal Act of 1965 was amended in 1970 to authorize the development of Federal guidelines for solid waste recovery; collection, separation, and disposal systems. Section 209(a) of the amended Act states that the guidelines shall be consistent with water and air quality standards, public health, and welfare considerations, and land use plans. These guidelines will apply to agricultural waste management systems, including animal waste management.

Several States are also drawing up guidelines regarding the location, design and operation of beef cattle feedlots to minimize the threat of water pollution. General design criteria are also being selected for modifying or developing runoff and waste handling facilities and for choosing ultimate disposal methods. EPA is providing assistance in this regard.

Need for Improved Technology

The development of more stringent regulations, along with guidelines, however, is not enough. If Federal and State statutes are to be met, animal wastes management technology must be sufficiently advanced so that truly effective, efficient, and economical pollution control systems can be installed. Because the nation's feedlots vary widely in their physical operating and financial aspects, it is mandatory that many alternative solutions be available.

EPA and USDA have conducted and are currently conducting research and development projects on new concepts in animal waste management systems. Some of the objectives are to characterize and quantify agricultural pollutants in waste waters and to develop treatment methods for removing them. Ways are also being sought whereby pollutants can be controlled by other than waste water treatment methods. Recycling and reusing animal wastes is a potentially fertile field for investigation. It is entirely possible, for example, that they can be converted into food stuffs if ways can be found to preclude the transmission of diseases, and this is by no means an insurmountable obstacle. It has, in fact, already been demonstrated that animal waste can be used as a substrate to produce algae and insect larvae, which can be fed to livestock and poultry, but the process is presently too expensive for practical application.

Rural Wastes Section—EPA

The Environmental Protection Agency has recently set up a Rural Wastes Section in the Office of Water Programs. This section is devoted to agricultural pollution problems, and will be addressing the overall problems of animal wastes. It will be developing guidelines for control, such as determining how much treatment is necessary, and will be providing direction in training and research.

The Environmental Protection Agency is also participating in a Task Force dealing with agricultural pollution set up by the Council on Environmental Quality. Through these efforts, EPA is hoping that it will be able to provide leadership and direction in animal waste management.

The last area of emphasis is the development of a staunch commitment to protect the environment. This commitment cannot be partial; it cannot be half-hearted; and it cannot be limited to particular groups. It must be a total across-the-board commitment. The livestock and poultry producers, I think, already have this commitment. What is needed, however, is direction and guidance, which EPA hopes to provide. Hopefully, stronger lines of communication can be developed with the nation's farm managers, so that the attack against animal waste pollution can be a cooperative effort.

Because of the restricted subject matter in this speech, some of you may have formed the opinion that the EPA considers animal waste management problems the sole *bete noire* of our beleaguered environment. Such is not the case. Such problems do exist, are growing, and must be resolved, but the same is true of all other forms of pollution. The anti-pollution attack, therefore, must be a balanced one, one that is aggressive while being realistic, and one that is total in concept. That is the approach the EPA intends to follow with regard to animal waste related pollution.

STATE ACTIVITIES IN ANIMAL WASTE MANAGEMENT

SUMMARY OF EXISTING STATE LAWS

WILLIAM STANWOOD CATH

Executive Secretary
National Association of State Departments of Agriculture

In summarizing the state laws and regulations that pertain to feedlot construction and animal waste runoff, it's not my purpose to give you a state by state comparison, but rather a broader group of actions taken by them at this point. I have been privileged to be an attendee at the animal waste conference at Atlantic City. I'm pleased to say that the information we have today as compared to that a year ago is much more complete, and I think we have seen some progress. Basically, you should understand and be very concerned with the development of state regulations as it relates to uniformity among states. Deane Conrad has this role to perform with the Council of State Governments and with the National Governors' Conference. We work very closely with Deane and appear before the Council of State Governments Committee on suggested State Legislation in Washington, to present model bills that have been developed either by industry working with state regulatory agencies, or by Federal agencies in conjunction with the state agencies and we try to have them adopted for inclusion in their manual of suggested state legislation for legislative reference.

There are two reports that I am quoting from one compiled by the U.S. Department of Agriculture on state regulations pertaining to livestock feedlot design and management and a recent report published by the Environmental Protection Agency, entitled, "State Agencies Regulating Confined Animal Feeding Operation." With it are a series of tables for individual states indicating those different state agencies that have responsibilities for water quality standards and feedlot construction and regulation.

These surveys cover those state agencies which regulate confined animal feeding operations. From this data collected I think we can make several observations.

Number 1. Eight states have passed specific feedlot statutes and/or regulations which require registration of confined feeding operations. In general, these regulations define, A. Terms used in confined feeding operations. B. Conditions which require registration. C. Information required by the state for feedlot registration. D. Minimum state requirements for waste management measures and E. Penalties for violations of the regulations.

In addition, several more states are actively pursuing adoption for specific feedlot regulations.

Number 2. All states have now adopted water quality standards which specify acceptable limits for various water quality parameters based on stream use classification. Waste discharges or runoff from confined animal feeding operations are subject to monitoring the restriction and legal recourse by State Water Pollution

Preceding page blank

Control Agencies, even though feedlots may not be specifically mentioned in these statutes and/or regulations. Therefore, there is at least one state agency in each state that regulates the operation of feedlots either directly or indirectly.

Number 3. In 29 states, confined feeding facilities can be legally constructed without the prior consent of a state agency provided that wastes, treated effluent or runoff from the site will not leave the premise of origin under other than catastrophic rainfall conditions. In many of states, approval for plans of waste treatment facilities—is mandatory. And the remaining 21, some formal state approval of the overall feedlot operating plans must be obtained prior to the initiation of operation.

Number 4. Even though feedlot construction permits may not be required it is considered unwise to construct such a facility or to initiate operations at an existing feedlot without first contacting, as a minimum, the state water pollution control agency, the State Health Department, and the State Department of Agriculture. The present trend toward more stringent state control over animal feeding operations is expected to continue.

Number 5. In many states, particularly the New England area, local health departments and zoning agencies exert considerable control over animal feeding operations, to public nuisance, sanitation and zoning ordinances.

Prospective feedlot operators should secure the approval of such local agencies during site selection and construction planning phases.

The definition of feedlots vary from state to state. Some states define an area in which livestock are confined and vegetation suitable for consumption by livestock does not grow. Other states specify a minimum number, not less than 250 head per year and confined at anyone time. Some states require a license to construct and operate a confined feedlot facility. Other states do not require a license or permit but this does not exempt the operator from regulation relating to pollution. Fees to operate a feedlot range up to 150 dollars. In most cases when fees are required they are graduated according to the size of the feedlot. In most states penalties are provided for violation of regulation, the penalties range from ten dollars to as high as a thousand dollar fine.

Generally, these are applicable for each day a violation exists.

Registration of new feedlots is a part of the published regulations. In some states existing feedlots are required to register within a specified time. In other states, existing feedlots are not notified of pollution potential and someone calls this to the attention of the pollution control authority. When this occurs, the control authority requires the operator to register the feedlot and to provide the necessary information. In some states feedlots would not have to register because of the size limitation but can register if they prefer to do so.

Now, in summary, a state has responded to the animal waste runoff problem in one of the three followig manners: either they have developed regulations concerning feedlot construction, they have control through their other existing regulations such as water quality standards or public health requirements or no specific regulations are considered applicable at this time.

STATE REGULATIONS PERTAINING TO LIVESTOCK FEEDLOT DESIGN AND MANAGEMENT*

WILLIAM F. SCHWIESOW

Agricultural Engineer, Agricultural Engineering Research Division
Agricultural Research Service

INTRODUCTION

Uniformity of livestock feedlot design and management regulations is desirable so feedlot operators in one State do not have an advantage over operators in another State. Information in this paper is being made available to governmental authorities and other interested people in an endeavor to assist in obtaining a deree of uniformity.

Figure 1 gives a quick reference to the status of feedlot regulations.

The adequacy of regulations is based on the opinion of the State Official responding and does not constitute a judgment or endorsement by the U.S. Department of Agriculture.

Development of regulations is a continuing process. Some changes may have taken place between the time responses were received and the date of publication. This paper contains information on regulations in possession of the author at the end of 1970 and an addendum covering reported changes to September 14, 1971.

Interest in the quality of environment has led to many requests for information on State regulations pertaining to livestock feedlots. A request was sent to each of the 50 United States of America for copies of regulations applicable to feedlot design and management. Forty-six States responded by December 1970.

SUMMARY

The following summary of material received may be categorized as follows:

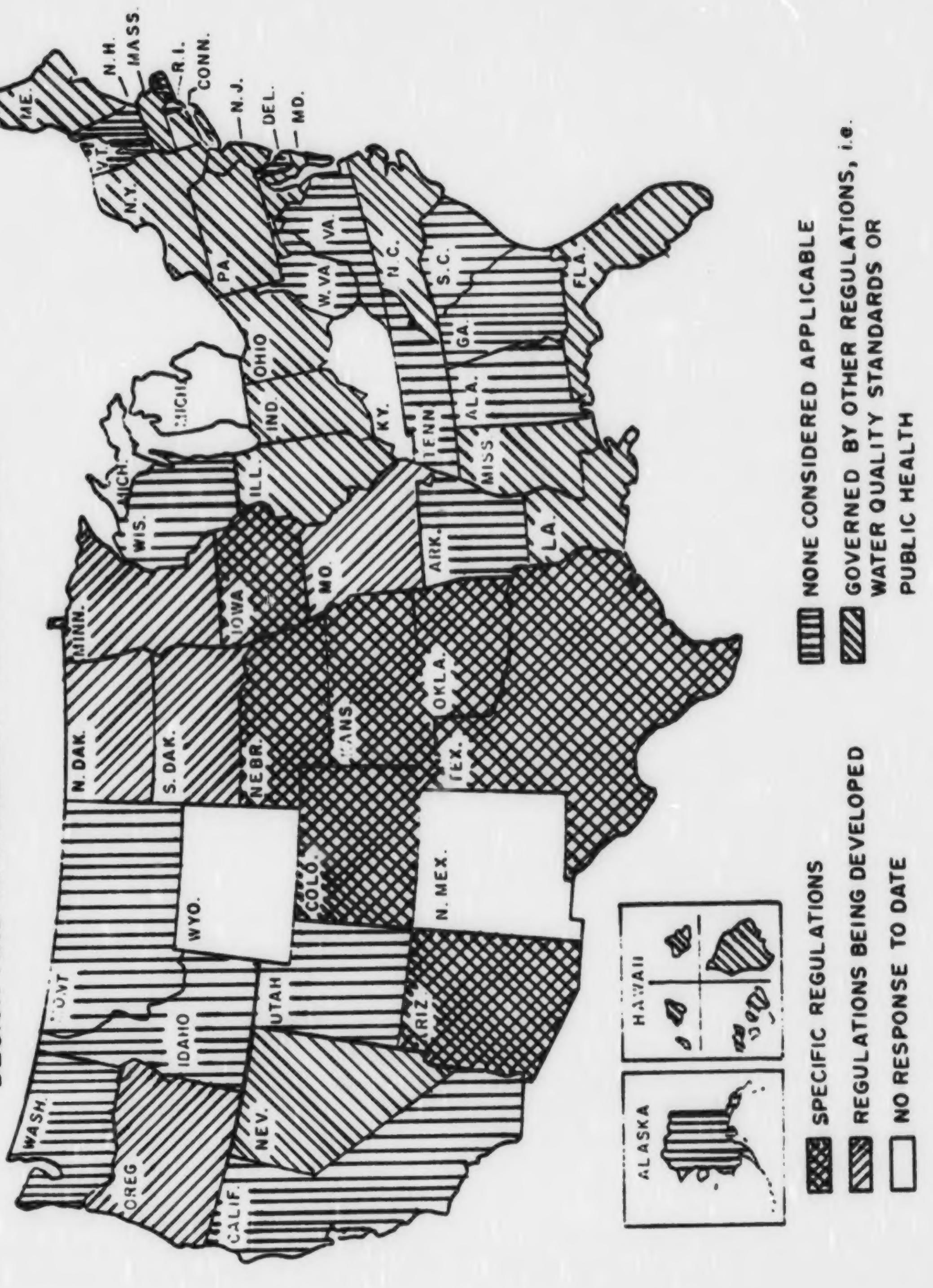
1. Regulations concerning feedlot construction.
2. Control through other existing regulations such as water quality standards or public health requirements.
3. No specific regulations that are considered applicable.

Arizona, Colorado, Iowa, Kansas, Nebraska, Oklahoma, and Texas have developed regulations pertaining specifically to beef cattle feedlots (*see* Appendix). These regulations were developed as a result of legislation related to water pollution control or, as in the case of Oklahoma, to specific legislation—"Okalahoma

---

*Based on U.S.D.A. Publication ARS 42-189 Prepared by Livestock Engineering and Farm Structures Research Branch, Agricultural Engineering Research Division, Agricultural Research Service, U.S. Department of Agriculture, Beltsville, Maryland 20705.

STATE REGULATIONS PERTAINING TO LIVESTOCK FEEDLOT DESIGN AND MANAGEMENT DECEMBER 1970


WASH.
OREG.
CALIF.
NEV.
IDAHO
MONT.
WYO.
UTAH
ARIZ.
COLO.
N. MEX.
N. DAK.
S. DAK.
NEBR.
KANS.
OKLA.
TEX.
MINN.
IOWA
MO.
ARK.
LA.
WIS.
MICH.
MICH.
ILL.
IND.
OHIO
KY.
TENN.
MISS.
ALA.
GA.
FLA.
S.C.
N.C.
VA.
W. VA.
PA.
N.Y.
VT.
ME.
N.H.
MASS.
R.I.
CONN.
N.J.
DEL.
MD.
ALASKA
HAWAII
SPECIFIC REGULATIONS
REGULATIONS BEING DEVELOPED
NO RESPONSE TO DATE
NONE CONSIDERED APPLICABLE
GOVERNED BY OTHER REGULATIONS, i.e. WATER QUALITY STANDARDS OR PUBLIC HEALTH

Feed Yards Act in 1969" provided the vehicle for developing regulations.

Definitions for feedlots vary from State to State. Some States define a feedlot as any area within which livestock are confined and vegetation suitable for consumption by livestock does not grow. Other States specify a minimum number (not less than 250 head per year) that are confined at any one time. Some States require a license to construct and to operate a confined feedlot facility. Other States do not require a license or permit, but this does not exempt the operator from regulations relating to pollution. Fees to operate a feedlot range up to $150. In most cases, when fees are required they are graduated according to size of feedlot.

In most States a penalty is provided for violation of regulations. Penalties range from $10 to as high as $1,000 fine. Generally these are applicable to each day a violation exists. Imprisonment is provided in some cases. Registration of new feedlots is a part of the published regulations. In some States, existing feedlots are required to register within a specified time. In other States, existing feedlots are notified of pollution potential when someone calls this to the attention of the pollution control authorities. When this occurs, the control authority requires the operator to register the feedlot and to provide the necessary information. In some States, feedlots would not have to register because of size limitation but can register if they prefer to do so.

Minnesota, Missouri, Oregon, North Dakota and South Dakota are actively pursuing the preparation of regulations that will apply to construction, licensing, and operation of beef cattle feedlots.

Alabama, Alaska, Arkansas, California, Delaware, Georgia, Idaho, Montana, New Hampshire, Rhode Island, South Carolina, Tennessee, Utah, Vermont, Virginia, Washington, West Virginia, and Wisconsin indicated that there were no specific regulations pertaining to construction and operation of feedlots.

Other States have regulations that they consider adequate at this time to take care of problems arising from animal wastes discharges. Connecticut has included animal wastes in their Public Health Regulations. Florida regulations under the Department of Health and Rehabilitated Services and Air-Water Pollution Control apply to the handling of livestock wastes. Hawaii State Department of Health has regulations pertaining to location and maintenance of livestock waste facilities. The Illinois Environmental Protection Act forbids the pollution of land, water, and air. Regulations for construction and operation of feedlots are planned. Indiana has a proposed Environmental Management Act that would provide the necessary means of regulation.

Louisiana depends on ordinances of local governments and the authority of Louisiana State Board of Health. The general nuisance law for the State of Maine is considered adequate at this time. Maryland Water Quality Standards are used to control the feedlot waste problem. Massachusetts has no specific laws; however, a report prepared by the State Department of Agriculture, the State Attorney General, and State Public Health Representatives states that regulations relative to handling and disposing of livestock wastes could be included in the State Sanitary Code, which is enforced by local Boards of Health. No further legislation is recommended until research results on waste management are made available. Mississippi depends upon regulations concerning the health and safety of residents to control any situation that may develop into a pollution problem.

Nevada has no specific regulations; however, liquid wastes would be controlled by tanks or lagoons to prevent entrance into the streams or irrigation ditches. New Jersey construction is regulated by local building or zoning codes and disposition of the waste is governed by Chapter 8 New Jersey Sanitary Code. New York depends on the Public Health Law. North Carolina has developed statutes relating to water and air resources. Livestock wastes can be controlled by this statute. Regulations will be developed as needed. The Ohio Water Pollution Control Act is applicable to commercial feedlots. Guidelines on waste disposal have been developed by the U.S. Soil Conservation Service. The Pennsylvania Clean Stream Law and related statutes under the supervision of the State Health Department are adequate to control and handle feedlot wastes.

Table 1 provides a quick reference to the status of 46 State regulations governing feedlot construction or operation or both.

All 50 States have water quality standards which have been wholly or partly approved by the Federal Government. These standards list acceptable biochemical oxygen demand (BOD) levels and other limitations such as bacteria level permitted in a body of water. These can be utilized by the State or Federal Government in enforcing compliance with the quality of waste discharged into a stream. Any wastes from a livestock operation would be subject to this review and subsequent control under the State Water Quality Standards. Recently passed legislation on air quality standards will cause the development of additional regulations for beef feedlot construction and management. Changes in laws applicable to pollution of water and air are expected to cause continuous changes in State laws and regulations.

APPENDIX

Regulations are published as "adopted regulations relating to livestock; providing for the licensing and regulation of beef cattle feedlots by the Livestock Sanitary Board, prescribing duties and powers of the Board, prescribing exemptions, prescribing penalties, and amending Title 24, Chapter 2, Arizona revised statutes by adding Article 9." Article 9 is entitled "Beef Cattle Feedlots" and includes sections on definitions; the feedlot operator's license, application, fees, exemption; disposition of the fees; standards of operation for feedlots; powers and duties; suspension or revocation of licenses; hearing an appeal; and unlawful acts and penalties. Also pertinent are the "Rules and regulations for the operation of beef cattle feedlots pursuant of Article 9, Section 24-391, 224-397, ARS inclusive." Section 1 is a statement of principle, Section 2 establishes the Feedlot Advisory Committee, Section 3 is rules of procedure, Section 4 lists feedlot categories, and Section 5 describes performance standards and code of operation. Under these regulations an operator's license is required for feedlots in excess of 500 head. The license is valid for a term of 1 year unless suspended or revoked for cause. Fees range from $25 for a lot with less than 500 head if the operator desires a license to a maximum fee of $150 for feedlots having over 10,000 head of cattle. The feedlots are classified into categories A, B, and C, depending on the nearness to the population center and public facilities, such as highways and streams. Waste management practices are specified for each category. A maximum penalty of $100 per day of violation is provided for those operators not meeting the established rules and regulations for operation of feedlots.

Colorado

Regulations are developed pursuant to the authority granted in the Colorado Water Pollution Control Law Sections 66-28-5 and 66-28-8 Colorado Revised Statutes 1963 (1967 Supplement). Rules and guidelines for water pollution control at livestock confinement areas have been published. These cite the authority; define terms that are pertinent to the livestock industry; describe measures that are necessary to prevent water pollution; provide general design criteria; specify the design criteria for retention systems, land application, and biological treatment; and include guidelines for construction of the evaporation and retention ponds. Each location is recognized as a unique problem and design and operation are treated in this manner. Penalties may be assessed where the operator violates a final cease and desist order.

Iowa

Regulations for the State of Iowa are developed under the authority of Chapter 262, Session Laws of the 63d General Assembly, First Session. Water Pollution Control Commission rules relating to feedlot construction and pollution control have been developed. They define the terms used in confined feeding operations, conditions requiring registration, the required information for registration, requirements for the facilities, and operation of the facilities. Three conditions require registration:

(1) The number of head confined in the feedlot exceeds 1,000 head.

(2) The feedlot contributes to a watercourse draining more than 3,200 acres of land above the lot and the distance to the

TABLE 1.

STATUS OF 46 STATES' REGULATIONS GOVERNING FEEDLOT CONSTRUCTION OR OPERATION OR BOTH

State	*Regulated*	*No specific regulations*	*Regulations being developed*	*Other regulations applicable*
Alabama		x		
Alaska		x		
Arizona	x			
Arkansas		x		
California		x		
Colorado	x			
Connecticut				x
Delaware		x		
Florida				x
Georgia		x		
Hawaii				x
Idaho		x		
Illinois				x
Indiana				x
Iowa	x			
Kansas	x			
Louisiana				x
Maine				x
Maryland				x
Massachusetts				x
Minnesota			x	
Mississippi				x
Missouri			x	
Montana		x		
Nebraska	x			
Nevada				x
New Hampshire		x		
New Jersey				x
New York				x
North Carolina				x
North Dakota				
Ohio				x
Oklahoma	x			
Oregon			x	
Pennsylvania				x
Rhode Island		x		
South Carolina		x		
South Dakota			x	
Tennessee		x		
Texas	x			
Utah		x		
Vermont		x		
Virginia		x		
Washington		x		
West Virginia		x		
Wisconsin		x		

nearest point on the affected watercourse is less than 2 feet per head of cattle in the feedlot.

(3) The runoff water from a feedlot or overflow from a lagoon or liquid manure storage tank flows into a tile line or buried conduit, drainage well, pumped well, abandoned well, or sinkhole.

Persons engaged in feeding operations before July 1, 1969, shall be notified by the Commission where potential pollution exists. They are then required to register and provide the required information. Anyone initiating operations after July 1, 1969, shall be registered if they fall within the conditions specified in the regulations.

Kansas

Kansas State Regulations are developed under the authority of the "Water Pollution Control Statutes applicable to the Federal Water Quality Act of 1965." Regulations adopted under this authority are Chapter 28 of the State Board of Health Regulations, Article 18 Agricultural and Related Wastes. The confined feeding operation for Kansas includes:

(1) Any lot that handles 300 or more large livestock.
(2) Any operation that uses a lagoon as a disposal area.
(3) Any other operation having a water pollution potential.
(4) Those operators that elect to come under these regulations.

Effective July 1, 1967, the operator of any newly proposed confined feeding operation must register before construction. Operators of existing lots must register by January 1, 1968. Requirements for the construction of facilities are listed and also the operation of the facilities is covered. Penalty for unauthorized discharge into the waters of the State shall be $1,000 per day that the offense is maintained. Penalties for failure to comply with the registration range from $50 to $500.

Nebraska

Nebraska regulations are under the Water Pollution Control Act, State of Nebraska, Chapter 71, Article 30. Water quality standards applicable to Nebraska waters were adopted by the Nebraska Water Pollution Council in January 1969. Rules and regulations for the registration of feedlots were developed. All feedlots must be registered if the maximum number of animals in confinement at any one time exceeds 300 or more feeder or fat cattle, 100 or more beef cows, 100 or more dairy cattle, 500 or more swine, 2,000 or more sheep, 3,000 or more turkeys, or 10,000 or more chickens, ducks, or geese, any feedlot that is located within 500 feet of any watercourse, any feedlot that may be a potential polluter or any feedlot whose operator elects to register. The U.S. Soil Conservation Service has developed a Nebraska Engineering Standard and Specifications for feedlot runoff control. Violators of the Water Pollution Control Act may be fined from $100 to $500 plus a further fine of $10 a day, together with costs for each day of violation. Imprisonment is provided under some sections of these regulations. In addition, if the death of fish or other wildlife results, the operator may be required to pay the State such additional sum as is necessary to restock the waters or replenish the wildlife.

Oklahoma

The Oklahoma Feeds and Yards Act of the 1969 Oklahoma Legislature governs the operation of feedlots in the State of Oklahoma. Any operator that has a feedlot capacity of more than 250 head of livestock at one time during a licensed year is required to obtain a license. Anyone that elects to come under the provisions of the Act may do so. The license fee ranges from $10 for lots under 250 head to $150 for lots having a capacity in excess of 10,000 head. Licenses may be revoked for failure to comply with the provisions of the Act or any regulations adopted thereunder. The Act stipulates that a fine up to $100 a day may be assessed for violation of these regulations. Rules and regulations to supplement the Feeds and Yards Act were published February 19, 1970. These include definitions, reservoir capacities for retention reservoirs, the provisions for the excrement disposal, pest control, drainage and veterinary services.

Texas

Animal wastes fall under the Texas Water Quality Act as amended in 1969 and the Solid Wastes Disposal Act. The Texas Water Quality Board, Waste Water Control policy for commercial cattle feedlots was developed. This policy statement applies only to commercial feeding operations, not dairies, holding pens, nor commission houses. A commercial feedlot is defined as, "Any confined area or enclosure for the feeding of cattle for marketing purposes, such enclosure not normally used for raising crops and in which no vegetation intended for livestock feeding is grown" There is no indication as to the number of head per feedlot to be used as a guideline. The policy statement contains broad design criteria within which installations should be developed. It is recognized that the feedlots are individual in character and must be designed to meet these individual characteristics. Permits issued under the Water Quality Act may be revoked or cancelled for failure to comply with the conditions of the permit or the Water Quality Standards. A civil penalty of not less than $50 and no more than $1,000 for each act of violation and for each day of violation may be assessed. Injunctive relief is also obtainable under the Water Quality Act.

ADDENDUM

A request for a report on the current status of regulations was made to each of the 50 states. The following changes were reported by September 14, 1971.

Arkansas reports that they have developed a quarantined feedlot program.

The Michigan Water Resources Commission and Michigan Air Pollution Control Commission have authority over water and air pollution from feedlots. Cooperative effort between the Michigan Department of Agriculture, Extension Service, Experiment Station, Soil Conservation Service, Water Resources Commission, and Air Pollution Control Commission insures that feedlot operators will have current knowledge of the various jurisdictions and sources of technical assistance available to them.

Mississippi depends on regulations concerning the health and safety of the residents. Rules and regulations are promulgated by the Air and Water Pollution Control Commission.

Missouri has prepared a final draft for a publication entitled "Missouri's Approach to Animal Waste Management" which covers the feedlot problems in that state.

The 1971 Nevada Legislature enacted Air Pollution and Water Pollution laws which cover feedlot operations. These laws are under the jurisdiction of the Health Division. The State Department of Agriculture has jurisdiction on feedlot design and management.

The North Carolina General Assembly considered a special bill for controlling the animal feedlot wastes in 1971. It is expected that such legislation will be recommended to the 1973 General Assembly.

Oregon has developed a final draft of regulations and guidelines for confined animal holding which has been submitted to the Environmental Commission for adoption. These regulations will require a person constructing or substantially modifying a confined animal holding or feeding facility to apply for a permit. Certain standards are prescribed and broad guidelines established to meet the varied conditions of the state. Final copies of the regulations are expected to be available toward the end of this year.

Pennsylvania notified us that the appropriate legislation is now enforced by the Department of Environmental Resources.

"Regulations of Livestock Enterprises for Water Quality Control" has been adopted by the South Dakota Committee on water pollution. A Public Hearing was scheduled for August 24, 1971, at Pierre, South Dakota. It was expected that these regulations would be adopted at that time.

Washington passed a feedlot law at the last session of the State Legislature and regulations are being developed under this new law.

Wisconsin reports that specific regulations have not been formulated. Regulations are being developed under the authority of Wisconsin's Administrative Code, Section Ag 10.01, Ag 10.26, and Ag 10.27 and Chapter 144 of the Wisconsin's statutes.

DEVELOPING NEW STATE LEGISLATION

R. DEANE CONRAD

Special Assistant
Council of State Governments

The stated purpose of the conference was to seek to come forward with proposals concerning research needs, legislation, regulation, enforcement, technical and financial assistance which will assure accomplishment of environmental objectives in a manner that will not place undue hardships on livestock and poultry producers.

Whatever the formula for achieving those goals the state component will be a necessary and vital factor in their success. I think we can allow the possibility that there just might be some need for additional legislation or at least some new regulations in some of the other states.

It is in order to hear about some of the problems of developing and implementing such legislation and regulations in the real world of state legislatures and regulatory agencies.

Inspite of what some of our administrators might believe, and certainly, virtually all of the press, legislators do go to the state capitols to work, but it isn't always that easy.

Bright as some members of Congress might be, there is in this great system of government an Executive Branch which has responsibility for implementing the law. In fact, they often have to implement and execute when there isn't any law at all.

Preceding page blank

MODEL STATE STATUTE FOR ANIMAL WASTE CONTROL

R. DEANE CONRAD

Special Assistant, Council of State Governments

The following comments and suggestions are made with respect to Appendix A:

Section 1—Definitions

(a) that the term "person" not be defined so rigidly as to prevent the operation of experimental studies and projects.

(c)

(1) That the term "feedlot" be deleted and the broader term "confinement feeding" be substituted therefore in this and all other sections of the statute, with the sense of the term "confinement feeding" being interpreted to include any feeding operation whether or not such operation be within a building;

(2) that the term "premises" be interpreted to mean one or more contiguous or nearby tracts owned or managed by the same person;

(3) that the number of livestock listed on Exhibit A, section 1(c) be left open for determination by the individual states, that the possibility of animal density as a criteria for registration be considered by the individual states when dealing with this problem and that the classification "horses" and "furbearing animals" be added to those listed in section 1(c); and

(4) that a clause enabling voluntary registration be added to permit smaller operators to enjoy the benefits of this legislation.

Section 2—Purpose

Given the ambiguity of the terms "all values of the environment," it is suggested that this section be redrafted to embody the idea that animal waste management should minimize the intrusion on the environment in the sense of the proposed North Carolina statute.

Section 3—Construction Permit Required

That the phrase "without first obtaining a permit" be struck and the phrase "without a construction permit obtained" being inserted therefore. The purpose of this change is to avoid ambiguity in the case of a person reapplying for a permit when his original permit has been revoked.

Section 4—Operating Permit Required

That the phrase "without first obtaining a permit" be struck and the phrase "without an operating permit obtained" being inserted therefore. The reasoning here is identical to that given under section 3.

Some sentiment was expressed for there being only one permit, with same covering both construction and operation. Thus, it is suggested that the merits of requiring separate permits be carefully examined by the legislature.

The argument for a two permit system goes something like this. Based on the experience in some states which already have a permit system, it is not unusual to see someone obtain a construction permit and then not build anything for a substantial period of time. If there is a 2-year limit placed on such permit, there may possibly be some advantage in making those who delay construction for more than 2 years, reapply for a new permit. Simply, new technology may have come along which makes the conditions placed in the old construction permits now sub-optimal. To this extent then a 2-permit system may help to protect one from himself where he is slow in acting.

Section 5—No Construction or Operation Without Compliance with the Conditions Set Out in the Permit

It is suggested that the sense of this section could be combined with section 5 then being omitted. As written, the section may be somewhat redundant.

Section 6—Application for Permits; Fees

The amount of the fee accompanying the application should be left open, to be set by individual state legislatures in light of workloads and local circumstances.

Further, that some states may want to strike the phrase "to cover the administrative costs of processing the application" by virtue of the fact that such fees may be paid into their respective "General Funds."

Section 7(a)—Circumstances under which Permit will be Granted

It is suggested that all references to interstate and federal agencies be deleted, as the inclusions of same may lead producers to believe that they are also complying with the standards of such interstate and federal agencies when in fact only those agencies can make this determination.

It is suggested that greater producer certainty could be added by quantifying and adopting "effluent standards" in a similar manner to those adopted in England, with such effluent standards being developed administratively under legislative standards.

It is suggested that this section be drafted so as to clearly recognize the problem of *air* (in addition to water and solid waste) disposal, as same is often inadequately recognized and is often characterized by inadequate or nonexistent air pollution standards.

Section 7(b)—Length of Permit Effectiveness

It is suggested that the word "valid" may be somewhat ambiguous, and that this section should be interpreted to mean that permits shall remain effective for the entire period of the permit so long as the conditions thereof are being fully complied with.

It is suggested that the 5 year period be deleted and that in lieu thereof the commissioner be authorized to issue such permits for the period he deems needed to fully amortize and recoup the investment in waste management and control facilities, taking into consideration the nature of the facilities and circumstances of each case.

Section 8(a) and (b)—Refusal, Suspension, Revocation of Permit

With respect to the second sentence of Section 8(a), it is suggested that language be inserted assuring that the animal producer will be given sufficient notice to respond (i.e., by registered mail, etc.). The action required for some will vary in different states, depending on the nature and content of their respective Administrative Procedure Acts.

Section 9—Commissioner Shall Issue Rules and Regulations

This section should specify the rules for public hearings if they are not elsewhere provided in their statutes. It is also suggested that an "advisory board" with technical management expertise should be established and relied upon in the promulgation of rules and regulations.

Section 10(a) and (b)—A Commissioner May Require Reports Submitted and Records Compiled and Inspect Some

It is suggested that this section should be redrafted to clearly protect the producer's right of privacy, given the Commissioner's right of inspection of some. To illustrate, financial and breeding records should not reasonably be within the Commissioner's powers of inspection, but rather only those reasonably related to waste management should be open to the commissioner.

With respect to subsection (b), it is suggested that the commissioner be required to give reasonable notice to the operator in order to assure that diseases will not be transmitted by those inspecting the feeding operations.

It is further suggested that the Commissioner's powers of inspection be limited to a reasonable hour of the day.

Section 11—Civil Penalties for Violation

Section 5 should be added to Section 3, 4, and 10.

Notice of when one initially becomes in violation should be required to be given the producer.

Consideration should be given to "legitimate" judicial appeals being interpreted to toll the violation period. However, care should be taken that operators not be permitted to temporarily avoid the statutory penalties by "spurious" appeals from agency decisions.

Section 13—Effective Date of Act; Revocation of Prior Laws

After the word "supercede" insert the phrase "or any law inconsistent therewith" so as to assure both "specific repeal" of old laws, as well as "repeal by implication" of prior inconsistent laws.

Section 14—Appropriation; Use of Fees

This section will vary in those states where all funds collected are required to go into the "General Fund."

Section 16—Name of Act

The name should be left to the determination of the state legislature considering adoption of this act.

The following suggestions are made with respect to materials not contained in Appendix A.

1. That a provision shall be inserted declaring that those operations in compliance shall be presumed to *not* constitute a nuisance, and

2. That the alternative remedy of injunctive relief by the Commissioner also be included in the act.

Recognizing the vital technical and educational delivery systems already in existence from federal, state and other public and private institutions available to the Nation's productive agricultural community and the evidence of cooperation by producers, we recommend the Congress and federal executive agencies closely coordinate with the States in the development of federal guidelines relating to animal waste management, leaving legislative and regulatory action in this area encumbent upon the several States.

States which have not already enacted legislation are encouraged to take preliminary legislative action to identify the parameters of the situation in the State, to be followed on a timely basis by appropriate legislation to apply constructive disciplines for animal waste management.

We recommend that State legislation provide protection to those in compliance against harrassing legal action and also provide stability in administration to attain orderly amortization of investment in animal waste management facilities.

PERMIT APPLICABILITY

Runoff from confined livestock and poultry operations due only to natural causes shall not be considered a "discharge," at this time, within the meaning of the term as applied to permits required under the Refuse Act of 1899.

Confined livestock and poultry operations are subject to the permit program if the given feedlot or facility contained 1,000 or more animal units (1,000 beef animals, 700 dairy cows, 290,000 broilers, 180,000 laying hens, 55,000 turkeys, 4,500 hogs for the slaughter market, 35,000 feeder pigs, 12,000 sheep and lambs, or 145,000 ducks) at any time during the calendar year preceding the filing of the application.

AND, (1) the livestock or poultry facility utilizes a man-made drainage, flushing or collection system (waste pits, ditches, detention ponds, lagoons, waste pipes, or the like), from which measurable waterborne wastes are regularly discharged, irrespective of rains or melting snow, into a navigable stream or its tributary, or (2) a regularly flowing stream into which wastes are directly placed traverses the feedlot or facility, or (3) there is a frequent overflow from a containment or retention facility.

Provided, however, that if the same operator has confined livestock operations at different locations or a feedlot which naturally drains in separate directions, and if the drainage, flushing, or collection system for each operating unit is separate and apart and discharges from a separate and distinct outlet or point and the waterborne waste from one system does not come together on the property of said operator with that from any other of his operating units, the 1,000 animal unit criterion shall apply to each separate operating unit, not to the total animal units on hand at any one time.

APPENDIX A

AN ACT

To Regulate the Construction and Operation of Livestock or Poultry Feedlots, and for other Purposes [Amplify to meet State requirements]

[Enacting clause]

Sec. 1. Definitions As used in this Act—

(a) The term "person" means any individual, partnership, corporation, other legal entity, or governmental agency of this State or any subdivision thereof.

(b) The term "Commissioner" means [identify appropriate State official].

(c) The term "feedlot" means any premises where at any time in the current or immediately preceding calendar year, the following numbers of livestock or poultry are or were confined for feeding or any other purpose:

1,000	beef cattle or calves or both
700	dairy cows or calves or both
4,500	hogs for slaughter
35,000	feeder pigs
12,000	sheep or lambs or both
180,000	laying hens
290,000	broiler chickens
145,000	ducks
55,000	turkeys or geese or both

Sec. 2. Purpose. This Act is intended to protect the environment from pollution by animal wastes emanating from feedlots.

Sec. 3. No person shall construct or substantially modify any facilities for use as a feedlot after [specify date] without first obtaining a construction permit from the Commissioner.

Sec. 4. No person shall after [specify date] operate any feedlot without first obtaining an operating permit from the Commissioner.

Sec. 5. No person shall after [specify date] construct or operate any feedlot other than in accordance with all conditions specified in the permit issued for such feedlot under Section 3 or 4.

Sec. 6. Application for permits shall be made to the Commissioner on a form obtained from him and shall give all information required to appear on the form by regulations issued by the Commissioner under Section 9. Each application shall be accompanied by a fee of [specify amount] to cover the administrative costs of processing the application.

Sec. 7(a). A permit will be granted only if the Commissioner determines upon the basis of the information in the application and an inspection of the premises involved that the operation of a feedlot on such premises will not violate any applicable mandatory water quality standards promulgated by the State, any interstate agency or any Federal Agency, or any other applicable mandatory State, interstate or Federal standards relating to air pollution, solid waste disposal, or other environmental values.

(b) Construction permits shall be valid for a period of two years from date of issuance and operating permits shall be valid for a period of five years from date of issuance.

Sec. 8(a) The Commissioner may refuse a permit or include conditions in any permit when he determines such action is necessary to assure compliance with the standards specified in Section 7. Prior to refusing or including conditions in a permit, he shall notify the applicant of the proposed action and afford him opportunity to present his views thereon. Any applicant who is adversely affected by any action under this section may appeal to the [specify court] which shall sustain the action of the Commissioner if it is [specify standard for review].

(b) A permit may be suspended or revoked if, after notice and opportunity for hearing is afforded to the feedlot operator, the Commissioner determines that the feedlot has been constructed, modified or operated contrary to any condition in the permit or contrary to any applicable standard specified in Section 7. The final order of the Commissioner shall become effective ten days after service thereof upon the feedlot operator unless an appeal is filed by him in the [specify court] within said period. The court shall sustain the action of the Commissioner if it is [specify standard for review].

(c) The provisions of [cite State law governing administrative proceedings] shall be applicable to administrative proceedings under this section.

Sec. 9. The Commissioner shall issue such rules and regulations as he determines are necessary to carry out the provisions or purposes of this Act. Such rules and regulations shall be adopted and published in accordance with [cite applicable State law prescribing procedures for issuance of rules and regulations].

Sec. 10(a). Each feedlot operator in this State shall make such reports to the Commissioner and maintain such records as the Commissioner may by regulation or special order require with respect to the construction, maintenance, and operation of his feedlot and any other matters germane to the objective of this Act.

(b) Each feedlot operator in this State shall afford to the Commissioner and his authorized representatives, access to all premises used in connection with the operation of his feedlot and to all his records with respect to the operation of the feedlot.

Sec. 11. Any person who violates Section 3, 4 or 10 of this Act shall be subject to a civil penalty of $ for each day that the violation continues.

Sec. 12. The Commissioner is authorized to accept financial and other assistance from any Federal agency for the administration of this Act, and to cooperate with any Federal agency or agency of any other State or governmental subdivision thereof in achieving the objectives of this Act.

Sec. 13. This Act shall become effective [specify time] after its enactment and shall then supersede [specify other State laws]. However, such other laws shall be deemed to remain in effect for purposes of sustaining any actions with respect to violations that occurred or rights that accrued prior to said date.

Sec. 14. There are hereby authorized to be appropriated such sums as are necessary for the administration of this Act beyond any fees collected under Section 6 and any sums received from the United States under Section 12.

Sec. 15. If any provision of this Act or the application thereof to any person or circumstances shall not be affected thereby.

Sec. 16. This Act may be cited as the [specify State] Feedlot Environment Improvement Act.

THE MINNESOTA SCENE LIVESTOCK FEEDLOT, WASTE CONTROL, PROGRESS—PROBLEMS

ROLLIN M. DENNISTOUN, Ph.D.
Minnesota Department of Agriculture

Regulations for the control of waste from livestock feedlots, poultry lots, and other animal lots were developed and officially adopted in April of 1971 by the Minnesota Pollution Control Agency. These regulations were developed to comply with the specific policy and purpose of the State of Minnesota in regard to solid waste control as set forth by Minnesota Statutes. Actual development of the regulations began some four years prior to the time of adoption.

The Department of Agriculture, while not charged with administering the laws and regulations relating to solid waste and subsequently to livestock feedlot waste control, did have substantial input into the developing of the feedlot regulations. This input was achieved through private discussions with agency personnel and by presentations at the public hearings held on the regulations prior to adoption.

The Agency has, since adoption of the regulations in April, prepared "Permit Application" forms which are to be completed by each operator who plans to "construct" and/or "operate" a livestock feedlot, poultry lot or other animal lot. The application includes those existing feedlots that are "nonconforming" lots, which means that they do not meet the standards or criteria of some solid waste regulations.

Land management and water management and control have received top consideration by the SCS and ASCS agencies for some time. The Agency and SCS are in the final stages of developing a working agreement covering the planning and installation of animal waste control structures.

Notices have been sent to a number of operators who are known to be having problems in this area advising them of the requirements of the regulations.

The Agency has also received voluntary applications for permits from twelve feedlot operators.

The Soil Conservation Service and the University have developed, over the past several years, some general plans for the control of animal waste from feedlots. Several feedlot operators, in cooperation with one or more agencies, have had installations made on their farms, and several field days have been held at these sites so that the public and other feedlot operators could view these installations.

This, briefly, is the progress that has been made in this area in Minnesota.

Even prior to the adoption of these regulations, we suggested that the program faced a number of problem areas. We believe these are still present, and that unless corrective measures are taken, implementation of these regulations will compound the problems of our rural areas.

1. Interpretation-Enforcement—Strict interpretation of the regulations as they are written will mean that 95% of the locations, practically without regard to numbers involved, having livestock of any kind in a confined area will be required to seek approval of the Agency. If the Agency feels so inclined, it could close any lot that does not meet the requirements until improvements are made. We suggest that enforcement under such possibilities will not be uniform throughout the State.

2. Availability of Funds—Many state and federal agencies are expounding long and loudly about the need for a "Rural Renaissance", or the slowing of the movement of the people from the rural areas to the big cities. Today's society thinks nothing of providing funds for improvement of city waste disposal facilities. This is necessary because people and protection of the environment are involved. Yes, some will say that funds are available to the feedlot operator, but we suggest that this operator, this person, a basic food producer, and one who prefers to remain out of the urban area is not provided the same consideration as are other segments of society. If it is the long run plan to improve and maintain these operations somewhat along the size they exist in today, adequate arrangements for proper financial assistance must be developed.

3. Education-Communication—The agricultural community throughout the nation has a long history of developing and implementing programs designed to protect and improve our environment, which, in turn, have provided us with a safe and abundant food supply. Yet, the changes being required of feedlot operators today are changes that cannot be made overnight and people must be made aware of this. Present research data must be available to those administering the laws and regulations in this area, because all too often these people are not knowledgeable in this area and they do not accept the fact that there has been and is responsibility in other agencies. Because of this deficiency, statements are made or requirements insisted upon that are improper, financially impossible to achieve, and certainly not conducive to the building of trust and understanding. Similarly, information must be provided to the public correlating the cost-benefit ratio to their level of input because a great majority of society today still has the false impression that food will always be cheap regardless of programs required.

4. Research—Dr. Wm. P. Martin, Head, Department of Soil Science, University of Minnesota, states that the only logical way for livestock wastes to be effectively handled is through the soil system, which includes the water phase. Soil is an essential link in the food chain from plants and animals to man. While much research has been done and more is presently under way, we believe that greater emphasis must be placed upon finding improved handling techniques so that the cost of handling and disposal will relate more directly to the actual value of the product to the soil and in turn to the production aspect of our total agricultural community. There is also need for greater coordination of research within given areas. While Minnesota can benefit from the research done in Nebraska, for example, the Minnesota agencies must do further research to take into account the different soil types and climatic conditions.

5. Duplication—This problem has been alluded to and everyone will support the contention that there is no such thing going on, but we believe that there is duplication in planning as well as in other areas and this makes it most difficult for an operator to know where to go for correct information. Funding also appears to be fragmented. A good part of this is brought about by the indecision of some agencies involved with the programs. For example, a research agency may recommend that a plan which it has developed will meet the requirements of another agency, but if an operator requests permission to construct such a facility, he may have real difficulty getting approval.

Environmentalists today are urging the necessity of management of our environment by objective and by a value analyses. We suggest that value analysis must receive greater attention, in so far as animal waste management is concerned. If this means more objective interpretation and enforcement, additional allocation of funds, better communication, more objective research, and less duplication, which we believe it does, then we need to get on with the job in order to bring the management of this objective, animal waste management, into proper perspective with all other trade-off concepts in deciding how much to take from our environment, where to take it, and how to leave that environment in the taking and the using.

STATE OF OKLAHOMA ACTIVITIES IN ANIMAL WASTE MANAGEMENT

BILLY RAY GOWDY

President, Oklahoma Board of Agriculture

The Oklahoma Legislature in 1969 recognized the potential problem of animal waste disposal and enacted a "Feed Yards Act", with administrative responsibility in the State Board of Agriculture. The industry to be regulated was in favor of the legislation.

A "feed yard" was defined as an area where more than 250 head of livestock were being fed for slaughter and in which there was no growing vegetation intended for livestock feed. The word "livestock" means cattle, swine, sheep, and horses. Public auction markets are excluded from the Act.

The operator of the feed yard must annually obtain a license from the Board of Agriculture. The cost ranges from $25 for a yard having a capacity of 250 to 500 head up to $150 for yards having over 10,000 head. Should anyone having a feed yard with less than 250 head voluntarily elect to come under the law, the license cost is $10.00.

The Board of Agriculture is authorized to promulgate regulations necessary to implement the Act. To assist in this function the Board appoints five advisors who must be feed yard operators. Since the law was enacted, one of the appointed advisors has always been a representative of the swine industry. Looking back after two years operation under the law, we do not believe we could have developed and written adequate regulations without the continued help of the advisory committee. The appointments to the committee are for three year terms. Meetings are at the call of the Board president.

An applicant for a license must fill out our application forms in sufficient detail and disclose as much information as necessary for the Board to determine his capability to comply with our standards and regulations. Failure to disclose adequate information can result in refusal of a license.

The Board is empowered to enter feed yard premises for inspection and investigate purposes.

Fees derived from annual licenses go into the State Department of Agriculture Trust Fund to assist, insofar as they will go, in the administration of the Act.

Our law requires the feed yard operator to (1) provide reasonable methods for the disposal of animal excrement, (2) provide adequate control of pests, (3) provide adequate drainage from the feed yard premise of surface waters falling upon the area occupied by the feed yard so as not to pollute any stream, lake, river or creek, (4) provide adequate veterinarian services to detect, control, and prevent the spread of livestock diseases, (5) have available for use at all necessary times mechanical means of scraping, cleaning, and grading feed yard prem-

Preceding page blank

ises, (6) provide weather resistant aprons adjacent to all permanently affixed feed bunks, water tanks and feeding devices, and (7) conduct feed yard operations in conformity with established practices of the industry as approved by regulations adopted by the Board.

Our law further states that any feed yard operated in compliance with the standard set by law and the Board regulations shall be deemed to be prima facie evidence that a nuisance does not exist. No feed yard, however, can be located or operated in violation of any zoning regulation.

The Board of Agriculture has the power to refuse, suspend or revoke a license. Procedures for doing so are governed by the Oklahoma Administrative Procedures Act which are uniform for all our state agencies relative to the required hearings, notices, and all other factors which protect both the rights of the individual and those of the state.

The penalty for violation of the law or regulations is a misdemeanor, punishable by a fine not to exceed $100, provided that each day the violation is committed, or permitted to continue, is a separate offense.

In our regulations "excrement" is defined as any waste material produced as a result of a feed yard operation.

A "pest" is defined as any insect, rodent, or bird which may be a hazard to the health and welfare of the public or feed yard operation. "Reservoirs" are excavated or diked structures, or natural depressions, provided or used for containing or detaining excrement. They may be for waste stabilization or for waste retention. When used for waste stabilization, the excrement is digested and stabilized before any release can be made. When used for retention, excrement is stored or retained for final disposal.

A "settling tank" is defined as a structure used for the purpose of separating the solid and liquid portions of excrement for final disposal.

Weather resistant aprons are required to be constructed of concrete, blacktop, compacted gravel, crushed rock, or other approved material.

By regulation, any waste discharge from a feed yard to any water course must be in conformity with the water quality requirements or criteria established for that particular river basin.

Waste water discharges from a retention reservoir can be made only for further treatment or disposal. The capacity of retention reservoirs must be adequate to retain the surface run-off from all waste contributing areas from a 2 day rain in a 5 year interval. Waste material must be periodically removed from retention reservoirs to insure adequate retention capacity. Various methods are permitted for excrement disposal. Spreading over farm land is preferred.

By complying with our regulation requirements relative to retention reservoirs, and by not having a "point discharge" as such, most of the industry in Oklahoma feels it will not be particularly affected by the 1899 Refuse Act. The problem of "odor" does not come under our law, but comes within the scope of the "Clean Air Act" administered by the Oklahoma Department of Health.

Oklahoma has another law, establishing a Pollution Control Coordinating Board, which has great influence on any potential water pollution from feed yards. The Coordinating Board is composed of 7 state agencies, including agriculture, all having some pollution control laws or responsibility, and 2 individuals appointed by the Governor. Should any state agency fail to discharge adequately its responsibility in the administration of any pollution law, the coordinating Board, by majority vote can initiate action in its own behalf. No state agency wants to suffer this rebuke and to date, none has.

As yet, no changes in our Feed Yards Act have been proposed to the legislature. The short comings most commonly mentioned to us are: (1) the numbers used for licensing purposes could be placed on the different pollution potential of the species involved, (2) the possibility of bringing within the law animal waste producing areas with sufficient numbers such as dairies, poultry operations, and particularly so-called preconditioning or background yards where livestock are assembled for distribution to feed yards, and (3) a method to adequately fund the enforcement of the Act. Without inspectors, a "paper" law is not of much value.

We have not had great difficulty with enforcement problems, and are grateful for no fish kills.

One hundred thirty-three feed yards are licensed by us, ranging in capacity from 250 to 40,000. Our total cattle capacity is about 300,000, swine 40,000, and sheep 15,000. The largest operations are in our three Panhandle Counties where the rainfall average is about 20 inches.

The Feed Yards Industry and its Waste Disposal Problems are very important to us. Oklahoma has about 5 million cattle and about 1/2 that many people. Agriculture is our largest industry, responsible for over a billion dollar income. Cash receipts from livestock and livestock products account for 78% of this total.

Oklahoma is said to have more miles of shore line created by man-made lakes to protect than any other state.

As a representative of a regulatory agency, it is our desire to administer our law and regulations so as to enhance the environment while recognizing at the same time the needs of an essential agricultural industry.

PROPOSED ANIMAL WASTE POLLUTION CONTROL LEGISLATION IN NORTH CAROLINA

MILTON S. HEATH, JR.

Associate Director
Institute of Government
University of North Carolina
at Chapel Hill

INTRODUCTION

North Carolina is in the process of considering legislation on the subject of animal waste control and management. During the recently concluded 1971 legislative session a bill proposing a survey and planning process leading to administrative controls was considered but not approved. In lieu of this bill, a resolution was adopted directing the Legislative Research Commission to study the need for such legislation and report back to the 1973 General Assembly. It can be anticipated that the usual process of study commission hearings, evaluation and report will be underway beginning in late 1971 and will produce recommendations by summer or fall, 1972.

As background for a few observations on proposals for animal waste management and control in North Carolina, it may be helpful to review the chronology of developments on this subject during the past year.

A Chronology of the 1971 North Carolina Animal Waste Pollution Control Bill

(1) *Latter half of 1970:* Consideration was given by the N.C. Department of Water and Air Resources and other interested agencies to developing a bill to be introduced in the 1971 General Assembly concerning animal waste pollution control—sometimes referred to in a shorthand way as the "commercial feedlot bill."

(2) *January 13, 1971:* The N.C. General Assembly convened in its regular biennial session. No animal waste bill had yet been prepared at this date.

(3) *January 14, 1971:* Governor Scott's Legislative Message noted that the Governor planned later in the session to deliver a special message on the environment.

(4) *January 15 to April 1, 1971:* An interagency steering committee inventoried and evaluated proposals from all State agencies for inclusion in Governor's environmental program. During the same period several major environmental bills that had been prepared prior to the Governor's call were under legislative consideration—including comprehensive bills concerning pesticide control, suface mining control, regional water supplies, and an environmental bill of rights.

(5) *April 18, 1971:* Governor Scott delivered his special legislative message on the environ-

Preceding page blank

ment. In it he endorsed most of the major environmental bills already pending. He also proposed legislation on a number of other subjects, including: an environmental policy act; an omnibus bill amending and extending various water and air resource laws; an omnibus coastal and estuarine protection bill; an oil spill control bill; an electric utility site control bill; and an omnibus bill relating to protection of the visual environment. Bills to implement these proposals were shortly introduced, totalling several hundred pages in length.

Governor Scott's environmental message included a recommendation that a new program for management of animal and poultry wastes be adopted. The interagency committee on the Governor's environmental program had presented a proposed bill that would have immediately established a waste control program based on mandatory permits for operation of animal or poultry production units. This proposed bill was not introduced pending the resolution of several questions that were raised in the Governor's office concerning details of the bill.

(6) *June 10, 1971:* Identical bills were introduced in the Senate and House "to control pollution from animal and poultry production units." The sponsors of these bills were, respectively, Senator Gordon Allen (S 774) and Representative Norwood Bryan (H 1229)—chairmen of the standing committees responsible for handling most environmental legislation in the Senate and House.

The bill, as introduced, used the framework of the original draft that had been presented by the interagency environmental steering committee. It modified the original draft primarily by substituting, in place of the mandatory permit requirements, provisions for an 18-month survey and planning phase concerning animal waste control. Specifically, it required: (1) the Department of Water and Air Resources to prepare a survey of the animal wastes problem by January 1, 1972, and (2) every owner of an "animal or poultry production unit" to file with the Department by April 1, 1972 a plan concerning control of waste discharges into or near streams, reduction of odors, and suppression of insects, vermin and pests associated with the unit. (An "animal or poultry production unit" was defined as an area designed or used, in whole or in part, for the confined feeding or holding of animals or poultry.)

Although the bill omitted the previously suggested permit provisions, it did retain a general rule-making power authorizing the Board of Water and Air Resources to adopt regulations governing animal waste disposal, odor problems, and pest control. Thus, the bill as finally introduced combined an inventory and planning procedure with general rule-making powers concerning pollution from animal wastes. While S 774-H 1229 had less immediate "bite" than the original draft, the retention of the rule-making powers made this bill more than a mere study and planning framework.

The bill expressly required that an Advisory Committee should assist the Department and Board in making the initial survey of animal waste problems and in developing any regulations and criteria on the subject. The composition of the Advisory Committee ensured a substantial voice for the animal and poultry production industry and for interested Sate agencies and university departments.

(7) *June 22, 1971:* H 1229 was given an unfavorable report by the House Committee on Water and Air Resources (Rep. Bryan's committee). No further action was taken on this bill or its Senate companion by the 1971 General Assembly.

(8) *July 12, 1971:* SR 961 was introduced in the Senate by Senators Allen and Patterson. This resolution directed our general-purpose interim legislative study group, the Legislative Research Commission, to conduct studies of eight designated environmental subjects and report its recommendations for legislation on these subjects to the 1973 General Assembly. Among the topics covered was "regulation and management of animal and poultry wastes."

(9) *July 14, 1971:* After a prompt favorable report from Calendar Committee, SR 961, the environmental study resolution, was adopted by the Senate. (In North Carolina either house may adopt a resolution directing an LRC study)

SOME CONCLUDING OBSERVATIONS

North Carolina within the space of the past year has developed three separate proposals involving legislation on animal waste management and control

The first proposal, a draft bill cast in the familiar form contemplating regulation through permits for all animal or poultry producing units, never was formally introduced for legislative consideration. The second proposal, retaining the general rule-making powers of the original draft but substituting a survey and planning phase for permit requirements, was introduced very late in the 1971 legislative session and died in committee. (Two related reasons probably account for the rejection of this bill: the lateness of its introduction, and the great volume of environmental legislation already under serious consideration when the bill was introduced. As a practical matter neither the standing committees called upon to review the bill nor the staff resources upon whom they relied could free the necessary time to prepare this bill for earlier introduction nor to adequately appraise it once it was introduced.) The third proposal, contemplating a study of animal waste management and control by the legislature's interim study commission, was adopted.

It would probably be a mistake to infer from the actions of the 1971 General Assembly, culminating in the adoption of the study resolution, that the subject of animal waste pollution control has been even tentatively "shelved" in North Carolina. On the contrary, the record of the Legislative Research Commission in recent years suggests that the subject will be thoroughly scrutinized in advance of the 1973 session and that legislative recommendations will be developed unless the study plainly indicates either that there is no serious problem or that existing laws provide an adequate solution.

The Legislative Research Commission is by law composed entirely of legislators appointed by the presiding officers of the Senate and House. But SR 961 (1971), directing the study of animal waste management and other environmental issues, provides specifically that the Commission may include non-legislator members on the subcommittee assigned these studies. And there is recent precedent for the practice of including non-legislator members on LRC subcommittees—e.g., the subcommittees concerned with environmental issues during the 1969-71 biennium. For example, a study subcommittee on pesticide legislation included representatives of affected farm and conservation interests, and of the land grant university, as well as legislators.

When the Research Commission addresses itself to the subject of animal waste management and control, it is likely to consider some of the same issues that have already been examined at some length during the past year. First, there is the matter of identifying the nature of those animal and poultry waste problems within the State that require attention. If it is concluded that some aspects of the subject require further legislation, several questions may then arise, probably including:

(1) The kinds of regulation and management best adapted to the particular problems of North Carolina.
(2) The meshing of any new regulation and management program with existing laws and programs. (While present state water pollution control laws could probably be applied to some cases of animal waste pollution, these laws are not well adapted to coping with the problem as a whole.)
(3) The timing of any proposed programs.
(4) The agency or agencies best suited to administer the proposed program.
(5) Depending in part upon the resolution of some of the previous questions, other issues may require attention such as, penalties and related procedures, financing, etc.
(6) Pertinent Federal laws and regulations.

STATE OF VIRGINIA ACTIVITIES IN ANIMAL WASTE MANAGEMENT

LARRY G. LAWSON

Assistant Director for Industrial Waste
State of Virginia Water Control Board

INTRODUCTION:

I intend to briefly discuss the following topics: 1. The Commonwealth of Virginia Water Control Law and how we apply it to animal waste; 2. The program used in certificating non-discharging animal waste treatment facilities; 3. The legal procedures utilized to obtain corrective measures, and 4. One of the major problem areas in the State involving animal waste and the area in which I hope this symposium will offer some assistance.

Virginia Water Control Law

The Virginia State Water Control Law, first enacted in 1946, was amended by the 1968 and 1970 general assemblies to broaden and strengthen the water control boards authority. The boards powers to regulate municipal and industrial waste discharges are well defined and the law specifically spells out procedures for certification of such discharges.

Agriculture Waste Sources

Waste discharges from agricultural operations may be broken down into two categories: point sources and areal, or diffuse sources.

The State Water Control Law as originally written applies principally to pollution caused by waste from a pipe or a ditch which drains from a fixed shore-based activity. These *point sources* can originate at centers of activity such as stock feeding lots or pens, dairying operations, hog "parlors", and the like. The discharges are usually in well defined concentrations, and relatively easy to control. On the other hand, the State Water Control Law, as originally conceived, was not written to cover diffuse sources of pollution. These *areal* sources of agricultural waste are likely to originate at land run-off and consist of such things as pesticides, fertilizer nutrients, and silt. The discharges are usually ill-defined, diffuse, and difficult to control. The 1968 and 1970 revisions of the law include a more broadly drawn definition of pollution, which may be applicable to diffuse sources of agricultural waste discharges.

State Approval of Point-Source Discharges

Since the adoption of the amended water control law in June 1970 we have become involved in approving treatment facilities for point source discharges of animal waste. Prior to that time we had no guidelines or procedures available for evaluating or approving animal waste treatment facilities. In an attempt to formulate some treatment requirements that we

Preceding page blank

would approve, several meetings were held involving the U.S. Department of Agriculture Soil Conservation Service and the VPI and S.U. Agriculture Extension Division. As a result of these conferences standards were drawn up for disposal lagoons. These standards have not been adopted as statewide guidelines, however, if a lagoon for treating animal waste is designed by the aforementioned agencies according to these standards then we will essentially automatically approve the lagoons. We have placed one stipulation on our approval of these lagoons and that is there will be no direct discharge from them to state waters. Therefore, the excess water that is not lost to evaporation must be disposed of by some form of irrigation.

In our approvals of disposal lagoons we consider the proposed facilities as an industrial waste application and process them as we would any industrial waste application. That is, upon receiving an application we advertise it in accordance with the law requirements. We evaluate the proposed facilities to determine if it has been designed according to our approved standards, and depending on the particular situation we may visit the location.

We also check the procedure that will be used to dispose of the excess water. If the proposed facilities are considered acceptable, we issue our approval in the form of a nondischarging certificate. Therefore, if there is a discharge from the lagoon to state waters they are in violation of their certificate. The entire procedure, from the time we receive an application until we issue a certificate, is presently requiring approximately one month.

Initially, when this program started we were not geared or prepared for it on a large scale basis. As are most regulatory agencies our reactions tend to move slowly at times and the approval of a lagoon was requiring a considerable period of time. Some of the owners submitting applications for state certificates were impatient and expected almost immediate results. As a result we changed certain portions of our procedures and the time for the issuance of certificates was reduced from the sometimes 3-4 months requirement, to, as I have previously indicated, approximately one month. We believe this is probably as efficient as we can actually perform the entire certificate issuance program.

The procedure that I have just discussed applies to both new and previously constructed waste disposal lagoons. However, thus far, the majority of the certificates that we have issued are for new treatment facilities. Before we became involved in approving animal waste treatment facilities there were many of the lagoons constructed in the state, and we have approved some of these existing facilities.

There are two major reasons that our program for approving animal waste facilities has been successful thus far, and both of these reasons are related to the USDA. The first reason is the cost sharing program sponsored by the USDA in which they will finance a certain part of the animal waste facilities. However, before they will actually issue the owner the money he must have a state certificate. The other reason is related to another requirement by the USDA in which an owner must have state approved waste treatment facilities before they will issue him a meat packing permit. Therefore, because of these two programs of the USDA, I am sure we are getting a lot of applications that we would probably not otherwise receive.

Surveillance and Pollution Complaints

We do not have the personnel to maintain adequate surveillance on all waste discharges in the state, and a good percentage of our time is spent investigating pollution complaints. When these complaints involve animal waste we contact the owner personally. Generally we have found that most of the owners did not realize they were creating a concern or that they were possibly violating water quality standards. After checking out the area we may discover that the problem results from the fact that they do not have waste treatment facilities or that the existing waste treatment facilities are inadequate. If this occurs we explain the law to them and point out that they are presently in violation. We have generally found that most owners are very willing to correct the situation. We suggest that the owner contact the VPI and SU Agriculture Extension Division or the USDA-SCS to answer any questions that he may have regarding the design of animal waste facilities. Excellent cooperation has been received from these agencies, and anytime that we have requested their assistance they have been more than willing to help.

Legal Procedures

If an owner refuses to cooperate with us and install acceptable treatment facilities or submit an adequate implementation program after we have requested him to do so, then we recommend that a hearing be called and the owner appear before the Board. If the owner refuses to follow the Board's directives then the problem is turned over to the Attorney General's office for whatever action deemed necessary. We use this legal procedure as a final alternative after all other measures have been exhausted. Thus far, we have resorted to legal action with only two owners involving animal waste.

Diffuse Sources of Animal Wastes

In my presentation, so far, I have only briefly mentioned diffuse sources of animal waste pollution. We have not become involved in the approval of these types of waste, in fact, we have not attempted to formulate guidelines that apply to diffuse sources of pollution. I hope that before this symposium is over some general guidelines will be available for use. In Virginia, we are blessed with estuarine waters that support a very productive shellfish industry. Since these shellfish are taken for consumption the coliform standards are very restrictive. In these particular areas, even though there may be no *point sources* of animal waste, the combined effect of all the *diffuse sources* may adversely affect the water quality and result in contravention of standards.

State Role in Pollution Control

I have previously discussed our state role in animal waste pollution problems. We function primarily as a regulatory agency, we do not design waste treatment facilities. We do, however, suggest corrective procedures that may be undertaken in order to obtain state approval.

In addition, we have not become involved in research to develop new methods of animal waste treatment, this has been left in the more capable hands of our state institutions. Since we do have an excellent relationship with these research personnel we have requested various studies be performed, and in the past, these procedures have proved to be a working relationship. And I do not foresee changes being made in the future. However, I am sure that we would welcome any additional research involving animal waste that may help in solving some of our present problems.

SUMMARY

In this presentation, I have briefly discussed various Commonwealth of Virginia pollution areas and ways these are being handled. The following summary observations can be made:

1. Our present state water control law applies primarily to point source discharges.
2. We have approved standards pertaining to non-discharging lagoons, and the procedures for issuing these types of certificates is well defined. However, there are still some administrative details to work out.
3. The present state law does not adequately apply to diffuse sources of pollution, and we need to establish guidelines that can be applied to these sources of waste.
4. Our legal procedures involving animal waste have proved workable in the past.
5. We have received excellent cooperation from the other agencies in the state that are involved with animal wastes.

DISCUSSION: STATE ACTIVITIES IN ANIMAL WASTE MANAGEMENT

FROM THE FLOOR: Martin Mully from the University of Illinois. I'm wondering if any of the states in developing regulation have put into the regulation any protections for the producer as far as civil suits are concerned after he has been registered? I don't know which one, you may direct this to one of them.

MR. DEANE CONRAD: I notice a great lack of enthusiasm in the field. You may note that it's a very germane, timely point that runs across virtually every area of legislation we have at the present time. Being a good academician myself, I think at this point I will defer to my temporary colleague, Professor Heath to see if he has some thoughts.

PROF. MILTON HEATH: Honestly, I don't know. Is there anybody here who is familiar with this question as it applies to this area. I can give you a general answer on regulatory legislation. But I really don't have an answer at my command on animal waste. Anyone here who knows the answer in this area?

FROM THE FLOOR: I believe that I read comments just recently that New Mexico did have some set provisions and they thought that it was holding up their development of their overall pollution control program. And that comment came from some of the cattle industry itself.

PROF. MILTON HEATH: All that I can really add to this is to reiterate what Mr. Conrad said, this is a problem that cuts across all of our regulatory business. In general, I think the usual answer is, that a regulatory statute of this kind probably would not be interpreted as depriving anyone, doing away with any civil remedies that would otherwise be available. It is possible to write provisions of that sort into such a law explicitly. If they are written into the law, someone who might otherwise who had a civil remedy, if you cater to him I'd contest the validity of that provision because probably some question legally might be raised as to whether you can validly take away a civil remedy otherwise available. But the effort is often made, the question is often raised and it may be possible without running into other constitutional problems to provide some kind of protection in the statute. That's about all I can add.

FROM THE FLOOR: Bob Yeck of the U.S. Department of Agriculture. Well, there is a point of correlation here between the standards and protection, like in court, our farm equipment industry has several times found some degree of protection in court from standards, if the standards are set forth, and the industry is meeting these standards this gives them some degree of protection when they do have to come before a court. So the value of a standard is very useful.

FROM THE FLOOR: You are right there, entirely.

FROM THE FLOOR: No question, but that's true. Whether the statute purports to

Preceding page blank

say or attempts to say that a remedy would otherwise be available is taken away. If you comply with standards you have some evidence of complying with what a reasonable person might be required to comply with.

MR. MEL GRAY: I was under the impression that Oklahoma also has this and parts of Colorado relative to the state—holding a license shall be prima facie evidence that they are not causing a problem or pollution nuisance in the sense that when you are correcting you can't take away the private law suit capabilities. I think one more factor which is extremely important, that the regulatory agency will stand up for a feeder who is in compliance against nuisance suits or allocation along those lines. It can be a very effective means also.

FROM THE FLOOR: Providing them with statutes or regulations in compliance would be prima facie evidence. Here is one of those intermediate solutions that might be available. To help protect.

Any other observations on this?

FROM THE FLOOR: Clyde Bower from Oklahoma. Our law does state that anyone who is in compliance with the law and the standards, that it is prima facie evidence that he is not a nuisance. Now, attorneys tell us that may be no better than good rebuttable evidence, that it may not save a man in court but it is useful as the gentleman over here said. Now, we have had one case that has been tried, they did not arrest as a nuisance, they alleged just straight damage suit. And it was on odor which was outside the confines of our law. But it is still on appeal. They were awarded a judgment but it's on appeal.

FROM THE FLOOR: Shouldn't some attention be given to the possible zoning, zoned agriculture, so that people cannot move in?

MR. DEANE CONRAD: I would first of all say that there is no way that zoning regulations could totally exclude bringing class action suits, but the fact of the use of zoning for agriculture is certainly a very interesting and relatively little used tool that I think we will probably hear a great deal more about in the course of this conference. Whether or not we want to defer until that point is up to you.

FROM THE FLOOR: Dick McGuire, New York, Farm Bureau. We just passed an agricultural districting law in New York State and this specifically spells out the rights of a farmer in an agricultural district once it has been set up. And one of these is that this serves notice on the general public, both people that move into or adjacent to the agricultural district that they cannot execute proceedings against farmers in that district because of odor, spreading manure, all these types of things that are accepted practices of agriculture. And this we feel has been accepted by the Environmental Conservation Department, they have approved the bill. There was no opposition in the legislature when the final bill was written. No opposition, I think it passed by a 95 percent vote. I think insures a good foundation for protection for farmers in agricultural districts where it is recognized by the public that this is a legitimate practice, common to agriculture and accepted by the Department of Agriculture, the College of Cornell and so forth. I might add, one of the reasons that there is so much emphasis put on this in New York State is, that we went through a law suit, court case, and many of you are familiar with and heard about the Gornokowsky case, a state farmer in Schenectady. And luckily I feel we won the case and after the thing was all over Mr. Gornokowsky said that he wanted out of the pig business anyway. But the fact remains that the rule which brought about the case. We had some 150 pending suits that many of them were thankful to the fact that because of the provision, the Board of Health and Environmental Conservation that limited the enjoyment of a man's personal property.

We had people who had arguments and fights and things, it was purely different from the problems, saying, "boy, here is a place I can get him, I got the law on my side now, because I can get rid of him." I think this is a special thing we have to take into consideration. Because when we set up procedures, rules and regulations and allow new suits to be instigated by individuals, the real purpose of the disagreement may not be connected to the thing that they use to win the argument. And I'm sure that the purpose of citing such as we had in New York State, New Jersey and some of the others, that this has to be considered.

MR. DEANE CONRAD: I agree. I think we are moving in the direction that New York has taken in terms of planning the future of agricultural communities.

PROF. MILTON HEATH: Let me make one observation on the zoning matter that occurs to me and it might be worth considering the fact that zoning could be viewed as a two edged proposition. It might be used as protection for agriculture, in this fashion or similar fashions. It also, if the suggestion were made, it might occur to some that zoning could be used conceivably as a means of protecting other public interests against agricultural occupancy of some types of land. What brought that to my mind was the mention of the estuarine problem in Virginia. One way zoning might be used on the other side of the fence which would preclude agricultural occupancy which might result. And problems which have not yet been solvable by regulatory methods we have. I think that might be worth taking that into consideration when you talk about zoning.

MR. DEANE CONRAD: For those of you who didn't hear, Senator Vanlandingham referred to some material on the back table that does relate to this very issue and points out the direction in a more measurable approach to the agricultural community of the Nation.

FROM THE FLOOR: Frank Kumack, North Carolina State. I'm wondering if we develop these laws if we are going to be able to get a homogeneous blend here. It moves moderately from state to state, recognize that each state has its own problems in different areas, handled by different methods of treatment. One thing that we hear commonly brought up is that this state is more rigorous than an adjoining state, therefore producers in that area are more competitive. How are we going to get a blend of uniformity in this criteria across the country?

MR. DEANE CONRAD: There are several people who can answer this very well. Stan, would you like to?

MR. WILLIAM CATH: I think it would be very easy for me to agree but to go back to the basic situation in the state legislature. You ask yourself, "where is the input and how stringent is the input from one side in this state compared to the input from the other side in another state." I think it's just basically the reason why we have this diversity of laws between states. This is something we are always going to have to recognize. The environmentalists particularly active in a particular state at a particular time or are the agricultural people more active in this state. You do have those states which are more agriculturally oriented than other states. We are going to have to always recognize that. But I think this is one of the questions that this particular conference will be able to help. To see the people at the State and Federal level of the different agencies can utilize their resources and try to bring them about.

MR. STAN CATH: I think if you said in a thumb nail sketch, the reason why we have state diversity of any law or regulations among the states is how strong the persons are at the state level, whether it's legislative, the development of laws and regulations. And I think this will forever be with us. But I think this is one of the purposes of this conference is to bring the people at the State and Federal level together and all the agencies involved in this problem, bring it out on the floor and see where they can utilize their maximum abilities, their resources to try and develop this as closely as possible, the uniformity of action at the State and Federal. Obviously, we are going to get it at the federal level together and the states should be able to conform to some degree in handling, in dealing with the animal waste problem. I think, historically this will be with us forever because no two states are the same in regards legislation.

MR. DEANE CONRAD: I would add one comment on this, namely that where there is need for more formal arrangements between states, many of them have been looking toward the establishment of a permissive interstate compact. This is an approach I think we are going to develop to provide greater flexibility in meeting common problems. We will have one final question before we take care of the animals before they are wasted.

FROM THE FLOOR: This is not a question, this is a comment on the previous question. In our quest for uniformity, I hope we don't forget that individual states have different environmental conditions. And a very good example of that is the thermal pollution problems related to nuclear plants raising the temperature of the water 3 degrees in Southern Florida might be too much. It might not be enough in Lake Superior in Michigan. The humidity and temperature are variants, I think that we have to design our program for individual environments, take advantage of it and not violate the environment. But not just to wrap up in uniformity that we don't have the good scientific program to fit their environment.

MR. DEANE CONRAD: You just made the classic case for state governments. I'd like only to affirm that what we are discussing in terms of model state legislation is just that. A broad framework for legislation which would be suitable to the individual conditions that obtain among the several states. Quite a distinction between that and uniform state laws which manifestly, we are not seeking, except where it is the most appropriate vehicle.

LUNCHEON ADDRESS

THE HONORABLE J. JAMES EXON

Governor, State of Nebraska

It has often been said that history repeats itself and in this respect those of us participating in the National Symposium on Animal Waste have a great deal in common with the early day residents of our nation.

The history of early-day travelers in the State of Nebraska provides accounts concerning the problem of finding clean drinking water.

The millions of buffalo which inhabited the area at that time congregated in the river basins and the only means feasible for the buffalo to protect himself from flies, gnats and other biting insects was to coat himself with mud.

This caused the river systems in the midwest during that era to be highly polluted from the activities of the buffalo.

With the slaugher of the buffalo and the introduction of cattle, together with the windmill, a great improvement was recorded to the extent that streams began to run clear and clean and problems of stream pollution were almost nonexistent.

Now we face another swing in the pendulum as the increasing size of livestock concentration, such as the increased size and number of feedlots, has created situations where problems of water pollution are very much the concern of society.

Yes, problems of human and animal wastes are not a recent discovery and some people who would lead you to believe they have only recently discovered pollution, fail to recognize that nature was subject to many great catastrophies such as floods and fires and that many of our today's beautiful forests were in reality malaria swamps before the advent of drainage and chemical insect control.

Pollution is a non-four-letter dirty word. Basically, pollution is nothing more than lack of respect for your neighbors' rights.

It is highly important that we recognize the dangers and hazards involved in excessive pollution of our rivers and atmosphere.

But let me stress that from the standpoint of the world's most highly regarded agricultural food and fiber production plant, it is also important that we maintain some semblence of balance in consideration of problems associated with pollution.

I believe our real concern is to take care of scattered pollution problems and to devise means by which livestock and poultry operators may help themselves from adding to the pollution problems of their states.

The management of livestock wastes has arrived on the scene as a new and major problem facing many producers. Those of us from Nebraska are confident that there is a great deal a state can do and we believe the results achieved in Nebraska indicate animal waste problems can be properly managed and controlled through state legislation, associated education programs and most important, by the cooperation of producer groups such as the

Nebraska livestock pollution control advisory committee organized in 1967 with Mr. William Krejci of Fairmont, who is here today, as their chairman.

One of the first key points recognized by this group, that represents all classes of livestock and poultry, was that "each feeding system will present its own unique opportunity for waste management and that each feedlot or system must be individually designed." That does not mean that this is a tragically complicated problem.

Nebraska's water pollution control act of 1969 makes it mandatory for producers to keep livestock wastes from flowing off their property or into watercourses. We have recognized the situation and we are moving!

To prevent wastes from flowing off the producer's property or into watercourses, waste control facilities are required. The act states that all waste systems are to be completed by December 31, 1972. Plans for facilities must be approved by the Nebraska Environment Protection Agency (EPA), the succeeding agency of the Nebraska Water Pollution Control Council.

In order to assist the livestockman, our various state and federal agencies recently developed a streamlined procedure to aid producers to obtain information for action on waste control facilities. Cooperating agencies include the Soil Conservation Service, Nebraska's EPA, the Extension Service and the Agricultural Conservation and Stabilization Service. We have recommended a series of documentaries and general suggested solutions be programmed on our statewide education television network.

Starting in 1967, the University of Nebraska College of Agriculture, in cooperation with the Agricultural Research Service and the U.S. Department of Agriculture, initiated an extensive multi-discipline research program involving several departments. These activities have been directed to obtaining information and data that can be used as a basis for the design of practical and economical waste control systems.

Based on a survey of 48 feedlots in 1970 by the Water Pollution Control Council, it appears that about 50% of our feeding systems may need some type of waste control. However, about half of these would require simple or inexpensive changes.

A state of confusion struck Nebraska's feeding industry this past spring when the Corps of Engineers permit program under the Refuse Act of 1899 was announced without adequate forethought or complete instruction or explanation to the livestock industry.

When the dust settled, it became apparent that if a Nebraska feeder has constructed and properly managed waste control facilities approved by our E.P.A., he should have no runoff, therefore, would not be required to apply to the Corps of Engineers for a permit.

With the cooperation that has been demonstrated by the livestock industry in Nebraska, I believe the goal of managing livestock wastes can be properly achieved by state legislation.

The consumers' stake in maintaining a high quality food product at a reasonable price depends upon the encouragement of keeping a strong feeding industry.

Unreasonable or too extensive regulations could cause a wholesale departure of smaller feeders from the ranks of livestock feeding. Since agriculture has not shared equally in returns on investment with the rest of society and since many businesses and industries secure public assistance with environmental problems it only seems logical to maintain and improve upon the limited cost-sharing program administered through the ASCS for the construction of livestock waste control facilities.

This assistance has been available in most counties during the past year and the incentive to reach necessary goals is heightened by necessary qualifications for cost-sharing that requires waste control facilities to be constructed according to engineering standards. Individuals must apply for assistance through their local ASCS office before construction is started.

Since a strong feeding industry is a prime requirement for strength in our economy and assurance of meeeing increasing demands for beef, hogs and poultry, I would recommend increased federal funding for this program as an incentive for a more rapid reduction in pollution potential and as a means of securing necessary proficiency in our design systems. By utilizing existing government agencies and providing proper inputs in information to the extension service, we can produce solutions to animal waste problems with less confusion and without having to set up a multitude of new agencies and developing new programs to meet pollution control goals.

With thousands of acres of prime agriculture land being devoured by other uses, it is time we should consider agricultural zoning. Why should a feedlot operator with a tremendous investment, where site location is vital, be at the mercy of society's whims. Zoning could provide specific areas for livestock production. Zoning can restrict the location of residential housing in areas zoned for agriculture. Zoning must be slanted to local control—as covered this AM—certain broad-level areas.

One of the first things we learned in Nebraska was that we were blaming the steer in the feedlot for more pollution than he deserved.

Yes, the 1,000 pound steer gives off 15 to 16 times as much solid wastes as one human. But remember we are talking about water pollution potential and while humans flush 75 gallons of water a day down the drain, a 1,000 pound steer doesn't flush anything until it rains at least one inch. Much of the solid waste stays in the lot to be hauled to the field. Also the steer doesn't take a bath, wash dishes or put clothes in a washing machine.

According to data obtained from the University of Nebraska field laboratory, only ten inches of a thirty inch annual rainfall will actually leave the feedlot. This amounts to about 3.41 gallons per steer per day of waste runoff to 75 gallons per human per day and you thus have a pollution ratio of 22 steers to equal one human.

If you compare the animal waste to human waste with these figures in mind, the population of Lincoln, Nebraska for example would be equivalent to twice all the cattle fed in the entire state for one year.

Many new and exciting events are occurring in animal waste control. Manure has long been a by-product and could become even more useful. Most recently, "Calf News" reported a new sensational building material called "ecolite" which can be molded to any shape, have any desired consistency, is five times as light as concrete, plus being fireproof, can be cut with hand saw, will take a nail and carries an attractive price.

The name "Ecolite" was chosen because the new product is a solution of two ecological problems—discarded glass and feedlot manure.

It is essential that the environmental issue be given time to be put on a rational basis for the sake of efficiency and economy.

We caution against the Corps of Engineers entering a field remote from the Corps' activities and expertise.

I believe Nebraska livestock interests are furnishing an example that animal waste problems can be solved basically at the state level.

The threat of unrealistic demands to meet pollution problems by cattlemen would cause a decline in cattle feeding and raise the consumer's cost of beef. Crash programs on pollution problems could lead to shortsighted outlooks when sensible, intelligent planning is the real answer.

While our subject today is primarily the matter of animal wastes, let me touch on an even more serious problem affecting water pollution in Nebraska and the nation. A matter of major concern is the pollution of not only our surface waters, but our underground water supplies, the latter of which is more abundant in Nebraska than any state in the union.

The problems, of course, are pesticides and fertilizers. Eutrophecation of our lakes by chemicals is the visible and easily definable catastrophe. While we have 26 or more agriculture scientists at the University of Nebraska involved with environmental pollution, we are still only scratching the surface, as it were, on the problems attendant with the leaching of fertilizers down and out of reach of the plant roots and eventually into underground water. I recommend a symposium, in the near future, on chemical pollution of the nations water resources.

We need expanded federal grants to our university to tackle the many sided critical problems in this area where we have provided leadership. Yes, our University of Nebraska is #1 in things other than football.

We cannot discuss agricultural pollution without at least recognizing the economic plight of Americas #1 industry! Recently I secured unanimous support at the National Governors'

Conference that Congress adopt the concept of stability and parity of resource earnings as the long-term goals for modern agriculture and then establish a national food and fiber board to develop the detailed production management programs necessary to insure an adequate supply of food and fiber for the future. The need for creation of a new house for agriculture policy is evident.

I am convinced that the very basis for a sound national economy starts with insuring a fair return to agricultural producers and that it is time a bi-partisan approach be developed to provide correct marketing information and to bring to agriculture the management tools which have been so long available for business. We must have less emphasis on just farm prices and focus on the parity of income principle.

Let me caution you here today that agriculture is no longer in the position to keep taking in less while paying out more to produce the highest quality and most plentiful supply of food in the world.

Society has the biggest stake in the future in its food supply—it is to the benefit of the consumers that the basis for all decisions reflecting on the welfare of our national economy and our food supply be tempered by the knowledge that we only succeed if our suppliers of food have the economic strength to meet their obligations.

An economically strong agriculture will bolster our national economy and be the forward and prime thrust on protecting our treasured national resources of land and water as we meet the ecological challenges of combatting the problems facing our livestock producers in managing livestock wastes.

SOLVING THE PROBLEM: A PANEL DISCUSSION

Moderator:

Norman Berg,
Associate Administrator, Soil Conservation Service, U.S.D.A.

Panelists:

Lloyd Essick,
farmer (rancher), Kanopolis, Kansas

Virgil D. Beougher,
District Conservationist, Ellsworth, Kansas

Bobby C. Heitschmidt,
County Executive Director, ASCS, Ellsworth, Kansas

Virgil P. Carlson,
County Extnsion Agent, Extension Service, Ellsworth, Kansas

L. Dean Strowig,
Area Engineer, Division of Environmental Health, Salina, Kansas

Norman Berg

There was a time, not too long ago when it didn't occur to very many, that livestock waste disposal would become the problem that would warrant a national symposium. The farm/ranch cycle was as natural as the sunrise and the seasons. We put the waste back on the land, into the soil, fertilized the crops, to feed the livestock that produced the waste. It was recycling at its best.

My experience, growing up on a farm as I did, we gauged the caliber of neighbor farmers by how they handled their livestock waste. My dad believed in having the manure hauled out everyday. In northern Minnesota that was no small task because the livestock were headquartered in the barn for about 6 months each year and in that country the snow was deep and especially in January and February it was a little bit chilly. I don't know how much good that manure did out there on some of those days, but that was part of our operation.

Imagine here then in a national symposium in this impressive setting, talking about this kind of a problem on the basis that we have 2.3 billion tons of it annually and we are not real sure what to do with some of it. As the Governor of Nebraska mentioned, perhaps it's not that much of a problem, if we put it into perspective, but we know of course with the attitudes that we have of the population of this country—the land uses that have changed—that animal waste disposal will have to take some new directions.

This panel has agreed to come from the center of the Nation. They come from the center of Kansas and we are grateful that they have taken time from their activities back home to do this.

They discuss a real life example of the various inputs that were used to solve and at least work with the problem of pollution abatement on a farm in Ellsworth County Kansas. This includes a farmer, and the local representatives of the Soil Conservation Service, ASCS, the Extension Service and the Kansas Board of Health. We hear about their problem. How they went about solving it and the results to date.

First farmer, rancher, Lloyd Essick from Kanopolis, Kansas. He tells me that he and his family operate the land, and represent four generations. They have over two thousand acres. They have a Hereford cow herd of about a hundred and fifty head. They summer about an additional hundred and fifty head of steers. During the winter they feed about 400 head of cattle until they weigh between seven and eight hundred pounds and they then are sent on to a fattening pen. He will lead off with discussing the kind of problems he had and what began to develop.

Then, Mr. Deane Strowig—the Area Engineer, Division of Environment Health, Kansas State Board of Health at Salina. Deane is a graduate of Kansas State University with a bachelors degree in civil engineering. He worked for a dozen years with a consulting engineering firm and the past eight years as Area Engineer for the Kansas State Board of Health and directs the engineering responsibilities for the Kansas State Board of Health in 16 counties in north central Kansas.

Next, Bobby Heitschmidt—the County Executive Director, of the Ellsworth County Agricultural Conservation Stabilization Office. He was born on a wheat farm in Ellsworth County, Kansas, he is a graduate of Kansas State University at Manhattan with a BS in Agriculture. Spent time with the Air Force, taught junior high school and has been employed in this particular position for the past eight years.

Next will be Mr. Virgil Carlson—the Extension Agent for the Extension Service in Ellsworth County Kansas. Also born, raised on a farm in central Kansas, 4H club member in his early days, received a bachelor and masters degree in agriculture from Kansas State University. He served as an agricultural instructor, has been an extension agent 4H club leader, presently in the position as County Agricultural Extension Agent.

Finally, Virgil Beougher—our SCS District Conservationist for the Soil Conservation Service at Ellsworth. Also born and raised on a farm in that part of the country. Has his bachelors degree in agriculture from Fort Hays Kansas State College at Hays Kansas. Began work with us about 17 years ago, moved around a bit. He spent two years away from the Department of Agriculture working with the John Hancock Life Insurance Company as a farm loan representative and has been back with the Soil Conservation Service for the last five years, presently as district conservationist working with the Ellsworth County Soil Conservation District.

I think you will find that these people based on their particular experience can demonstrate that the problems can be complex, but there can be solutions. It's a teamwork effort. And as somebody remarked this morning that when you are in this metropolitan area of Washington, perhaps you don't always know where to go for help. But I would suggest that when you are out in the field that people do know who can do something about their problem as exemplified by this group here.

Now, this certainly doesn't represent the only solution to a problem or perhaps the final solution. There are other groups that could be represented, but this is a team that has a story to tell and we are pleased to have them.

Lloyd Essick

(Slides used.) This is a picture of the map of the State of Kansas showing Ellsworth County almost in the geographical center of the state. Our feeding operation, as Mr. Berg pointed out to you is a small family operation. Due to the fact that a lot of people have been talking pollution and especially in our agriculture area, agricultural pollution, the son and I wanted to make some major improvements to our feeding operations and we decided that we better find out what we had to do to control the pollution before we made any changes in our operation in the way of fence line bunks, concrete aprons, etc.

Our old feedlot, as you can see here, was an ideal location as far as it went. It drained down the draw below there, crossed this pasture for probably two or three hundred yards, into this little pond. This little pond is a beautiful spot, spring fed, full of fish, neighbor kids, grand kids like to fish there, some of them even swam in it, ideal for that purpose. However, as you can see along the shore line, the weeds growing and I think enough pollution that has killed all the fish in the pond.

Just below the dam on this pond is the boundary line between our own privately owned land and the land owned by the US Government in the Kanopolis reservoir area. This land is so close that we thought we should do something to control this runoff.

So, we went up and talked to our local conservationist, Mr. Beougher. That's a picture of the beach at Kanopolis Reservoir, which by the way has become quite a recreation area in the central part of Kansas. We went in and talked to Mr. Beougher about what we could do to control our pollution. He informed us that funds were available, on the basis of 50 percent through the ASCS, and CAP, REAP, whatever you want to call it. So I applied for the funds and getting approval on the ACP payments. Our local group of district supervisors which operate in our county came out and looked the deal over, there they are looking at the little pond that was polluted below our feedlot.

In order to get the ball rolling, it was necessary to make applications to the State Board of Health. We filed that application, a group of gentlemen came out, Mr. Strowig, Mr. Frank Kinsey, Mr. Boeugher and myself standing there discussing what we should do.

Our old area had quite a drainage from across the road and after looking that over and the adjoining areas, they recommended that we go to a new site on the opposite side of the building site. This draw was the site that we selected, you are looking directly north there. The drainage, slope and everything sort of fit the operation.

After going this far, the Soil Conservation Service sent their survey crew out to survey it, draw up the plans to be submitted to the State Board of Health.

Our county agent, Mr. Virg Carlson, after discussing plans for pen arrangement, came up with the unique idea of triangular shaped pens that would fit the area and enable us to handle a larger number of livestock in a given area.

This is the design as drawn by the Soil Conservation Service showing the outline of the pens in yellow, the diversion terrace, the dark, heavy green line with the arrows, points the direction of flow in the diversion channel and the red heavy mark is the dam or lagon below the diversion terrace.

This is Mr. Strowig, State Board of Health, studying the plans after which he approved them and we could start the construction. We think we have a real operating pollution control system. And I would like to show you what it looks like since it has been completed. Here is an airplane view of the completed structure as far as pollution control. We don't have the pens all finished, there will be more pens to each side of the diversion channel and you can see there the channel diversion and the channel itself which drains back to the top just below the triangular pens, which has a small tube, an eight inch tube, slows down the ruoff and enables the solids to settle out in the diversion. The nice part about this operation, we don't have to have a lot of high priced equipment to handle this cleaning operation. This diversion dries out, you get in there with an ordinary farm tractor, a scoop, clean it out, haul it out on the fields.

This is a picture taken this past summer after about a ten inch rain in a 24 hour period. You can see there the diversion about half full of water and it took from about 12 to 15 hours for that to drain through into the lagoon, letting the solid wastes settle in the diversion terrace.

Here is the little pipe that runs through the top end of the diversion showing the water draining out into the farm. You can see the upper end there of the pipe, you can see some of the sediment, we haven't had cattle enough in there yet to get too much solid waste, but you can see some accumulation there, that pipe, I think, is the contributing factor to the success of our pollution control system.

One of the requirements of the State Board of Health in the State of Kansas is that you have available pumping equipment. Here we show where we have cleaned up some of the manure in the pens prior to hauling it out on the fields. This is a centrifugal pump that we have on lease, along with here a sprinkling system that we can used in case we need it to pump this water out of the pond below the diversion terrace and sprinkle it on either adjacent grass land or farm land that lies less than a quarter of a mile away.

Here again is the completed system showing our farmstead, you are looking north, you can see the old feedlot to your right of the building. I'd like to call your attention to the background or top part of that picture, that is a view probably six miles, and I want you to notice the terraces, the contour farming and especially to the right of our old feedlot that wind break, shelter belts we call them in Kansas. That particular shelter belt was one of the first in Ellsworth county planted back in the middle 30's by a good old neighbor and our silos, trench silos sit just across the road to the south of it. On a cold winter day when the wind is blowing, I'm telling you that is surely appreciated.

Our hope is that with this completed project and some of the experiences we have gained through this operation, that we can help other people overcome their problems. I also want to add that our cooperation between the different governmental agency involved in this thing has been tremendous. You can't hardly believe until you get involved in the thing. I also want to say that it has been a privilege and a great deal of pleasure to me and my son to be associated with this group of gentlemen here on the platform as well as you fellows out there. Thank you very much.

L. Deane Strowig

I regret that I don't have slides to show you, I wouldn't know what to say about them anyway. I'm the dirty old state health engineer that came out and cracked the whip. but it isn't really all that severe. As an area engineer for the State Health Department, I wear many hats. And I don't call myself expert in any one of them. My job as an area engineer is to be an extension of the chief engineer who happens to be in the crowd today so I have to be careful what I say.

Be that as it may, one of the principal works in which I along with others in the state are involved is to coordinate work on feedlot and animal waste problems.

The background on this is that you have heard mentioned briefly in 1967 in the State of Kansas, initiated legislation or corrective legislation at least to clarify the position of the animal industry in Kansas relative to the waste, and how we can eventually handle this. And from this evolved the Department's responsibility with the State Health Department through the guidance and counseling and overseeing of the eleven august members of the State Board of Health. And from this were developed the regulations which we used to exercise this control.

Now, I won't dwell on the regulations because other than to give you the four principal points by which we are guided. Reference was made this morning to Kansas along with other states and how they are regulating or controlling and so forth, the ones that have taken action in the publication at the rear, and I have glanced over that and find that it is essentially correct. Anyway, the four conditions for confined feeding in Kansas are that you should have three hundred or more head of animals. Now it doesn't say any one particular animal it just says three hundred or more. I think it mentions cattle, horses, swine, down the line, it has more than one category. The second condition is, that if you are presently using a lagoon for any kind of waste retention or treatment that of course, this lagoon must be looked at by us and to see that it is sufficient to do the job in our opinion.

The third condition is, is there a pollution potential? And of course our staff are the ones that said yea, nay or elsewhere. And the last condition of course, is voluntary registration.

Now, at the time we started this of course, the Department of Agriculture did not have a REAP program since it's new, I believe within the last year. And so we embarked on literally, on a crusade or shall we say, missionary work of trying to keep peace within the agricultural community along with the State Health department and this is quite a story really, but I don't know if it needs recounting particularly. There was considerable turmoil about this, but nevertheless since we had staff and we had people who were, shall we say, knowledgeable in the science, although we were rather neophytes in the handling of animal waste, we have to admit that. Come to think of it, there were quite a few over the country, because we were trying to pick the brains of a number of people and found that there were very little brains to pick. So we became pioneers I guess. Now Mel, you feel free to correct me whenever I step on your toes. I should mention, Mel Gray is my boss, he will be moderating workshop C tomorrow, so I would give him that opportunity to correct me.

But nevertheless, out of this, came the Department's responsibility. At the present, let's see, this goes back to about a week and a half ago when I had my last meeting with some of the state SCS people, the state office happens to be in Salina so this serves a real job purpose for me and I just wrote the contract, and I know some of those fellows real well. I know he doesn't want me to mention his name but I should tell you that one of the finest efforts I have ever seen has come from a young man named J. D. Rudger, he just did a fantastic job in putting this thing together in a cooperative movement with us. But be that as it may. About a week and a half ago, the SCS had in their files roughly 330 out of 1,450 registration applications were being processed by them. Now, this is quite a number and most of those have occurred this year. But roughly we have 1,470 registration applications on hand. That comes from the smallest farm operation right up to the largest cattle feedlots.

I am going to mention a little something there about Kansas now being third in confined feeding, where they used to be fifth not too long ago, I guess I don't need to mention that.

We are very proud of our cattle industry in Kansas. We think we have some terrific people in that and we think the industry is growing rapidly.

Now, project procedure. You might be interested in this. Of course, the farmer or the feedlot operator, he will file with us, because the law says he should, or voluntarily as I mentioned earlier. Then if he wants to participate through cost-sharing program, with the REAP program, then as has been mentioned briefly in the slides he will contact the district conservationist. The first question which is asked of him, when he says he wants to do this, have you filed a registration application with the State Health department. And if the answer isn't yes, then he must do so.

Now, we don't get so bound up in the red tape situation where we can't be flexible. So what I tell my, I say my, as the district conservationist in the SCS area engineers of which I work with three. I tell these fellows, that if you encounter a farmer and he has not registered with us. Then make the date for us to appear at his place and when we are on the spot then I will get him properly signed up and it will be mailed in and so forth. There is no need to put the delay in there, if we can get our scheduling set, there is no need to delay this business about, well, you got to fill the dang thing out and send it in and wait for it to come back, like that.

There is no point in this at all. So this is the way we are working. Then the DC along with the SCS area engineer and the owner and myself, we meet at the site, and we look at problems and we take into consideration such as soil conditions, general topography, of course it bends, like was earlier mentioned in 16 counties in north central Kansas, rainfall patterns vary considerably. Our basic rainfall design concept over the state, state-wide, is that we design on the basis of a one day ten year storm. SCS engineers being quite expert in soil and rainfall and watershed and that sort of thing are very well equipped to handle these problems.

Now, the numbers, before they got in the game with us, the numbers we were using were very much akin to the numbers that they used all the time and extract from a particular problem. But, I dare say they do their work much better than we do, much finer work.

So, well, usually, well the DC and the owner and who ever else might be there are discussing, I suppose the different little aspects of the problem. The SCS area engineer and myself, we get our heads together and we walk over the terrain and get things kind of lined out. Now, prior to this of course we have had meetings on the state level so that the State Office of SCS can hand out the proper material for guidelines, we lovingly refer to as the green sheets. These technical guides are strictly from criteria that are agreed upon between the two departments, two agencies. And we have a meeting of the minds about this. And there are several different systems that are used in pollution controls and there are a number of them. And they have these numbers that are used.

Once the show gets on the road then, and we decide how we are going to get rid of this "shud," I don't know if that is a new term to many of you or not. It's obvious where it came from. That's Kansas vernacular folks, "shud" you can quickly decide what it stands for. But believe me, it's very descriptive. Now, when we figure out what we are going to do with this stuff and basically we are talking about feedlot problems, cattle feedlots. Of course with hogs you don't have shud you just have something else. Nevertheless, the DC and his crew they go out, you saw the picture. And they do the surveys and get the information together, and the area engineer for SCS with this design criteria, mutually agreed upon, set forth, he lays out a plan. Delivers the plans back to the owner. The owner then submits to me three copies. If it happens to be a case where, like for example, I'm gone at this present time, and to keep the machinery working he might very well just hand one of the chaps out a petition. Well, I would have had to look at it, but chances are they won't because they are too dang busy looking after others, they have too many fish to fry, so it will have to wait until I get back. It's kind of like mowing the lawn, it's going to wait until you get back.

So, with these plans being sent to me, I review them. Now, any approval, stamped approved, this means they are o-kayed by the department, must come out of our Topeka office. This is the way we operate. The central office in the state capitol must know what is going on at all times. Of course the mountains of memos and things of this sort, I sympathize with Mel and all of the paper work he has to do, but nevertheless, that's the way we do it and he has people helping him in there of course. Now, they take my review and my approval memo or my recommendations and then they stamp them or write a letter or whatever the particular situation calls for and usually it's approved, ones that I have recommended for approval.

Then, this is sent back to the owner. And the owner keeps one copy and gives the SCS man one copy and I should have mentioned that one copy stays in Topeka. And here everybody concerned has a copy except me and I guess I'm not supposed to have one, but that's all right, I have already committed it to memory so it doesn't really matter. Then work begins and the project is completed. Under the supervision of SCS which we really admire them, the men and how they go about work. I'm not trying to blow them up and make them look all glorified or anything but I admire the way they do these things and the kind of work they produce. Because, I'll be frank with you, if it's a small feeding operation where we are involved we will give this design, very minimal drawing with specs with a letter or something of this kind. We will tell the guy to get a conservation contractor, if he can find one and try to do this along the lines of a project as if it were under SCS supervision. And we would expect this type of work to be done. And we would go off and leave him, and if he doesn't have a question we won't come back until he says he is through, unless it happens to be a little larger operation. Then in which case we will make frequent checks, unannounced of course. Nevertheless, once the project is completed, then we do go back and have a joint meeting and go to the side and nod our heads and then we issue a permit and so forth. This is the way it is generally wrapped up. I don't mean to make light of it, because it is a quite serious situation, because animal waste in kansas has some problems. Our streams, you know, are not pristine pure like they are in shall we say, the upper regions of Colorado and some places like that, where they photograph the Core's beer ad and all that. But nevertheless, we feel like there is an urgency to keep these streams as clean as possible.

Then the permit as I said is issued and the operator proceeds. Now, these permits are conditioned on the basis that the operator is going to stay about in the same ball park as he started with the number of animals or size of area. And if he chooses to make the change and we here use the term significant, and that ought to be a "Jim Dandy" to try and evaluate. But if he makes a significant change in his operation then we have to be, we ask that he notify us so that we may come back and reassess the situation. And possibly ask him to increase his water pollution control facilities.

Now, in closing, I should tell you that here again I don't want to glorify SCS particularly, but I want to say to you as a group that my association with these fellows has been, well, top drawer. I have enjoyed the association and I continue to enjoy and I know I will in my particular work because we are right down on the scene, we are right down, like they say, where it's happening. And it's been a real pleasure to do this. I can't give you any department policy or department statement or anything of this kind and what I say is strictly my own thought, but I just couldn't agree with anybody more than what he says concerning the control of waste from the local scene and this is the place to do it.

Bobby C. Heitschmidt

I was recently reminded of the absent-minded farmer standing out in the middle of the field with a rope in his hand. He couldn't remember whether he lost a horse or found a piece of rope. My memory is not much better, however, this piece of rope is to remind me that I should discuss the Rural Environmental Assistance Program this afternoon. Cost-sharing dates back to 1936 when it was known as agricultural conservation programs, or as we know it in short ACP. A major—has contributed to the total environment in Ellsworth County is reflected in the following accomplishments:

Since ACP has been started in 1936 we have completed two thousand acres of waterways which is approximately three sections or a small ranch. We have completed eighteen hundred and seventy three miles of terraces which is the distance from here to Santa Fe New Mexico. We have built one thousand twenty farm ponds and have seeded back to grass five thousand four hundred and six acres which is approximately eight sections.

We still have a hundred and twenty six thousand acres of crop land needing terraces and waterways in our county. There they are needed to solve our greatest pollution problem, sediment from soil erosion.

Cost-sharing encourages farmers to use conservation practices. Requests for cost sharing far exceeds funds allocated. The success of the program is aided by the cooperation of government agencies and other interested groups. And I would like to say here, again, that we have full cooperation with SCS, county extensions, farm/home administration in our county.

In 1970 the Ellsworth County Committee added the new animal waste practice to the county program. The county conservation group recognized that funds would have to be reduced on other conservation practices to be made available for these new practices.

This practice in Kansas was limited to a maximum of one thousand head of livestock, which is beef cattle, or an equivalent number of other type of livestock. The purpose of this limitation was to exclude large commercial feedlot operations. It was believed that the large commercial feedlot operation would install the needed waste disposal system because it was required by law on their own. The practices was further limited on cost sharing to earth moving and necessary conduits for collecting and disposing the waste.

Each year an investment plan is developed by the county conservaton group. The plan is based on total conservation needs, past accomplishments and county pollution problems. This plan also establishes cost sharing priorities to be used by the county committee in approving requests, because requests greatly exceed available funds, so only the highest priorities are approved. Taking into consideration the farm needs. We could call Mr. Essick a pioneer becaus he was the only farmer in Ellsworth county to use the pollution abatement practice in 1970.

The total cost of his practice was approximately twenty-two hundred dollars. Cost sharing, was half or eleven hundred and fifty dollars: Mr. Essick's practice has made more Ellsworth county farmers interested in controlling animal wastes. Since this practice has been expanded in 1971 to include concrete and metal liquid manure tanks, we have had three additional requests which were approved for two hog farms and dairy farms, and one dairy farm for this liquid manure tank. In our county we have learned that farmers are publicly spirited individuals and are interested in improving the environment without economic returns to themselves. And I think you can see this by Mr. Essick, what he has done on his farm.

If the Rural Environmental Assistance Program is continued many farmers will build or construct the needed conservation practices in Ellsworth county to stop pollution. And we are hoping this practice will be continued.

I think I can sum up what we are doing in Ellsworth County, Kansas when it comes to pollution by quoting something I saw on a church bulletin board. "We are working to beat the Devil".

Virgil P. Carlson

One of the requirements of a feedlot site is to have a slope of at least five percent. This will insure good drainage. And in past years if it was on a drain-way in which flood water would periodically flush it out, so much the better. So the old feedlot of Lloyd and Dave Essick was ideal by the old standards. As you see it has a good slope. Today, it's a different ball game. The pollution problem has been recognized, new rules and guidelines have been established.

This is a diagram of the Essick's new feedlot. It has retained the desirable features of the old lot and has added several new ones. You can see the contour lines there and know that it has adequate slope, it has about eight percent slope away from the fence line bunks, insuring good drainage of the area. It has a southern exposure which gives it maximum drying and this cuts down on the odor and the drainage will move this shud down through the diversion terrace. And you will see that the diagonal lines there represents the cross fencing. This particular design allows the cross fencing to go up and down the slope interfering in a minimum way with the natural drainage of the area

The yellow border is the weather proof perimeter road that will allow the Essick power feed wagon to go on the outside of the feedlot, depositing the feed in the fence line bunks. The fence line bunks are in red there. In each lot, the fence line bunk is three hundred feet long allowing a hundred and fifty head to feed in each lot. There are six lots which makes a total capacity of 900 head. It is also noted that there is an established wind break to the north and this will give maximum wind protection and comfort to the animals during the winter time resulting in more gain.

The design of the pen arrangement is triangular as compared to the conventional rectangular of the old lot. The triangular has several advantages on this particular location. The triangular design allows as we said, most of the cross fencing to be up and down the slope and then the cattle are easier to move in a triangular shaped pen, thus saving time and labor. All the pens are served by the one lane which leads to the working corral and you see on the diagram there the black line that is parallel, that is the lane that serves all six pens. And it will lead across the road then to this working corral which will perform the function of loading and unloading the cattle, holding them and sorting them and working them.

The Cooperative Extension Service does provide design information and layout service for various livestock enterprises. And as county agents, becoming involved in several of these. If the local county agent feels he needs assistance, we always have our extension specialists in agricultural engineering to give us assistance.

I believe that this plan is the best solution to the problem that Mr. Essick and his son had at this particular location. And this solution was possible because they recognized the problem and had the concern and desire to do something about it. The plan that was only possible to solve this pollution problem, this plan not only solved the pollution problem but it also increased the efficiency of production. The plan had the excellent cooperation and team effort by the local government agencies. In my opinion, the cost-share practice under the REAP program is a great encouragement to keep small ranchers and farmers in business who otherwise might quit when faced with a pollution problem. After all, the main objective of our ongoing and expanding Rural Development Program is to keep them down on the farm.

Virgil D. Beougher

I would like to stress three significant factors in the development of the animal waste abatement system on the Lloyd Essick farm, who became a cooperator with the Ellsworth Soil Conservation District about 15 years ago. The first and most important factor, I believe was for Mr. Essick deciding that he had a problem with animal waste pollution. He could see what the raw animal waste was doing to his farm pond in which his family and neighbors used to fish. Therefore he could see the effects of pollution on larger bodies of water such as the Kanopolis Reservoir. He was looking for a solution to his problem when he requested help from the various federal and state agencies. The second factor I believe was the cooperation between the states and federal agencies in working together with Mr. Essick to help him solve his pollution problem. The first was with the State of Kansas Department of Health and Mr. Strowig in providing rapid service in outlining the facilities needed to comply with the Kansas state law. Second, the Agriculture Stablization and Conservation Service with the County Office Executive, Bobby Heitschmidt who was swift to approve the cost-sharing application for payment.

Third, the planning of cattle pen arrangements and sizes to fit slopes and contours of the abatement practices by the county agent, Virgil Carlson to accommodate the feedlot of one thousand head.

Fourth, was the cooperation with the Ellsworth County Soil Conservation District, Board of Supervisors who visited the proposed project and set a high prority for planning and construction.

The third significant factor I believe is the flexibility of the Kansas SCS specifications and standards for a facility to process concentrated organic wastes from feedlots. Structural designs of the system are the same as for other soil and water conservation structures that SCS has been using in other programs for many years. The construction of the project was done by a local conservation contractor using the same equipment that he used for other conservation work and not having to purchase any special equipment.

Each abatement system is designed to meet the economical needs of the individual livestock operator. He can use the machinery that he has available now without purchasing any special or new equipment to dispose the organic wastes. This reduces the cost of cleaning the solids and wastes in an approved manner. Pumping equipment must be available, either leased or owned to empty the storage reservoir within a specific period of time. This liquid can be pumped and disposed of on grasses or on nearby crop land fields.

The system has been seeded to grass this last spring to prevent the erosion from water and to help beautiful the project. In closing, I think we have helped to develop a rural area of America by implementing this animal waste pollution abatement system. It has taken the cooperation of the state board of health, ASCS, the Extension Service, Soil Conservation District Board of Supervisor, Soil Conservation Service and Mr. Essick working as a team in putting together the component parts of this system to make it work.

My list, I think, will help minimize health hazards it will reduce the source of pollution and improve the environment of the local farm, the community, the state and the Nation.

Norman Berg

The Department of Agriculture for several years has tried to identify the agricultural-related pollutants, the magnitude of the problem, and to begin to analyze the needs that are going to have to be met in the future. That there can be answers to these problems that will fit the local situation.

One of the serious questions that I think we face is the fact that the environmental quality that we are going to try to achieve, is something that we can not price, like the pound of meat, like the loaf of bread. But it does bear a price tag, it's a two-sided one. One side is represented by the management costs, the efforts spent and the way society reacts. And the other side will be the cost of correction and prevention. Whatever the pollutants may do the question that will continually press us at every level, regardless of our interest is whose going to pay for this cleaner environment. Somebody is going to have to put up the hard cash for additional research, extension, cost-sharing, loans, technical assistance, and especially from the standpoint of the landowners, the producers, the cost that he will have to contribute.

He is not in the favorable position of being able to run his product through the pricing mechanism and then after he gets a bid of being able to say, "well, now add two or three cents to the price of that steer because I had a pollution free feedlot." We need to come up with answers as to who should pay and how much. There is debate about the fact that the polluter must pay the full rate. What will be the role of government at the local, State and Federal level? How can we identify the beneficiaries and cut them in on the costs?

The latest environmental report from the council on Environmental Quality, their second annual report, does not identify the scope and magnitude of this problem. Perhaps it indicates the need for this national symposium—to focus on the kinds of problems that we have ahead in the agricultural related pollutant field. But we who have worked with the Department of Agriculture, throughout the three thousand counties in the country have a delivery system that can help. And as we soon move into the third century of national experience I think you'll find from the people such as we have heard from today, that the Nation can adapt to the changing demands and needs of society in a way that reflects that we'll get on with a better agriculture and a better rural environment that will contribute to the whole Nation.

RESEARCH AND TECHNOLOGY

EFFLUENT DISCHARGE GUIDELINES AND ANIMAL WASTE MANAGEMENT TECHNOLOGY

HAROLD BERNARD, JEFFERY DENIT, DONALD ANDERSON

Agricultural & Marine Pollution Control Section
Office of Research & Monitoring
Environmental Protection Agency
Washington, D. C. 20242

Environmental Review of the Animal Feeding Industry

By way of a general introduction to the concepts to be pursued in this discussion, it is appropriate to review briefly the basic characteristics of animal and poultry production operations with emphasis directed at elucidating those aspects of current practice which relate most dramatically to the degradation of the quality of watercourses.

In essence, today's meat production enterprise has evolved from a myriad of influences, technological improvements, and economic constraints. In retrospect, it is not without a significant degree of coincidence that the earliest configuration of the family farm homestead serves as the basis for the massive animal production complexes now in vogue. Granted that in the past the vast majority of livestock was raised on the "open range." But at the same time, small pens and "chicken coops" served as the essential facilities near farm homes.

From this rustic setting there has evolved the technological process, production-oriented concept of the confined feeding enterprise. Small animal pens and chicken coops, originally and historically utilized as readily manageable facilities for the subsistence of one or a few families, have burgeoned into large, often massive, meat production operations with all of the trappings of an industrial factory. Any single "factory," the production system for which is depicted in Figure 1, may be capable of providing food for hundreds, if not thousands of people.

Roofed or not, paved with concrete or not, heated and airconditioned or not, these present day "Coops" now house thousands of birds or animals in one spot. This confined, concentrated circumstance has resulted in the capacity to provide consumers with a virtually limitless supply of meat, poultry and related products.

We have arrived at the "age of the feedlot." More animals are housed, more feed consumed, and more meat produced in any given restricted locale than ever before. Regardless of the essence of the physical facilities themselves, e.g., loose confinement or total housing, the trend toward the housed "production line" philosophy portends many of the same burdensome and costly consequences now confronting "heavy" industry. For in addition to the consummable products, feedlots (a term used henceforth to

Preceding page blank

encompass any confined animal or poultry operation) now produce upwards of 1.5 billion tons of raw manure annually. The small, readily managed chicken coop of by-gone years would scarcely be recognizable.

Environmental impact notwithstanding, under these situations the physical problem of merely keeping the pens, barns, or houses even reasonably clean can be overwhelming. For example, present waste handling systems for open, and many closed cattle feedlots involve extensive expenditures for collecting, scraping, hauling and field spreading. The labor and equipment (e.g. front loader, tractors, augers, or spreaders) are significant fixed cost items which effect a direct drain upon a farmer's time and capital. Moreover, efforts to obviate the need for these predominately manual methods have not proven entirely effective. Sloped lots, paved lots, underdrains, interceptor ditches, berms, grassed waterways, and similar measures have successfully reduced much of the labor and equipment expenses and in many cases alleviated the immediate, *on-site* waste problems. However, increasingly frequent, damaging discharges of rainfall runoff from feedlots into watercourses are occurring because these measures often serve to accomplish little more than to concentrate and direct runoff discharges. When coupled with numerous instances of non-point runoff occurring in the absence of any controls, the results are increasingly costly and intolerable social economic externalities as water supplies, recreational areas, and aquatic life are despoiled and befouled.

Further efforts to improve the general efficiency of waste handling and disposal led feedlot operators to try to counter these problems by adopting the use of retention basins, lagoons and similar waste collection or treatment structures. As a result, the need for manual waste handling procedures was further reduced and the frequency and impact of water pollution incidents were alleviated.

It has become evident, however, that these structures may have engendered a false sense of security on the part of farmers who installed them. Instead of having a problem solved, the farmer found that odors associated with biological activity in the pond and requirements to remove and dispose of solids and accumulated sludges proved to be problems as vexing as any ever before encountered. Moreover, it was soon discovered that whenever these ponds overflowed, the effluent was equally as pernicious as raw runoff.

Faced with the prospect of having to make further refinements in their waste management systems, many farm operators halted individual attempts to resolve their problems and sought help from professionals throughout all levels of government and private industry.

Because of the complexity of the total problem of feedlot runoff pollution, as confounded by the vast variety of individual problems and lack of refined abatement and control procedures, farmers frequently found that little or no real help could be provided. Nevertheless, the inquiries posed by farmers fostered an analysis of feedlot pollution by technical experts throughout the country. This analysis led to a rather comprehensive disclosure of the essential elements which interrelated to comprise the animal production system, and the waste management concepts and environmental impact attributable thereto.

It was readily apparent that three primary considerations governed both the nature of the runoff problem and the potential for abatement or control. First, with rare exception, the waste discharges from feedlots are diffuse, and non-point in origin and consequently are not amendable to the classical waste treatment technology long developed for (and associated with) readily defined, controlled discharges from a pipe. Second, the waste flow to watercourses is almost entirely intermittent as related to rainfall and snowmelt. As such, the predictability of the waste flow in terms of volume, duration and quality is far from reliable in comparison to most sewered wastes. Moreover, variations in the nature of the runoff between rainfall events and spring snowmelt serve to confound efforts to prescribe essential waste quality baselines. Third, and perhaps most significant, the waste discharges are probably the most variable in quality, yet consistently strong in organic constituents, of any other waste stream. Quality will vary due to the precipitation factors noted above; there exist obvious differences in wastes between broad classes of livestock and poultry.

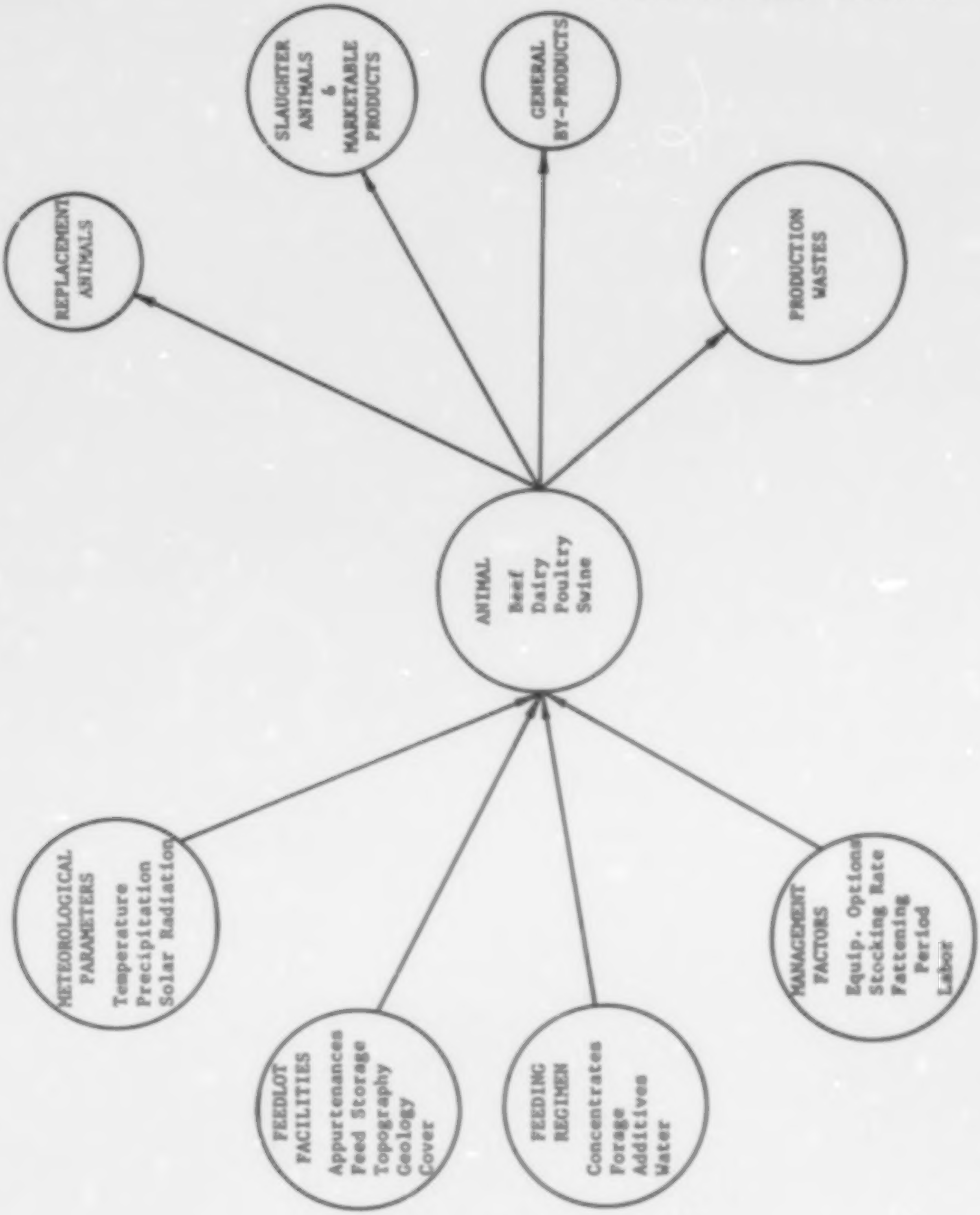

REPLACEMENT ANIMALS
SLAUGHTER ANIMALS & MARKETABLE PRODUCTS
GENERAL BY-PRODUCTS
PRODUCTION WASTES
ANIMAL
Beef
Dairy
Poultry
Swine
METEOROLOGICAL PARAMETERS
Temperature
Precipitation
Solar Radiation
FEEDLOT FACILITIES
Appurtenances
Feed Storage
Topography
Geology
Cover
FEEDING REGIMEN
Concentrates
Forage
Additives
Water
MANAGEMENT FACTORS
Equip. Options
Stocking Rate
Fattening Period
Labor

Figure 1: Schematic of Animal Production System

More perplexing, however, is the problem of variability of wastes as related to feed inputs, the nature of housing, ambiant temperature, breed and age of animals and a host of other factors which vary across and within geographic, cultural, jurisdictional, and sociological boundaries. Recognizing that the "standard" or "average" livestock or poultry operation simply does not exist, the schematic shown in Figure 2 can be used in conjunction with Figure 1 to provide a general delineation of this complex of waste management considerations which confront feedlot operators.

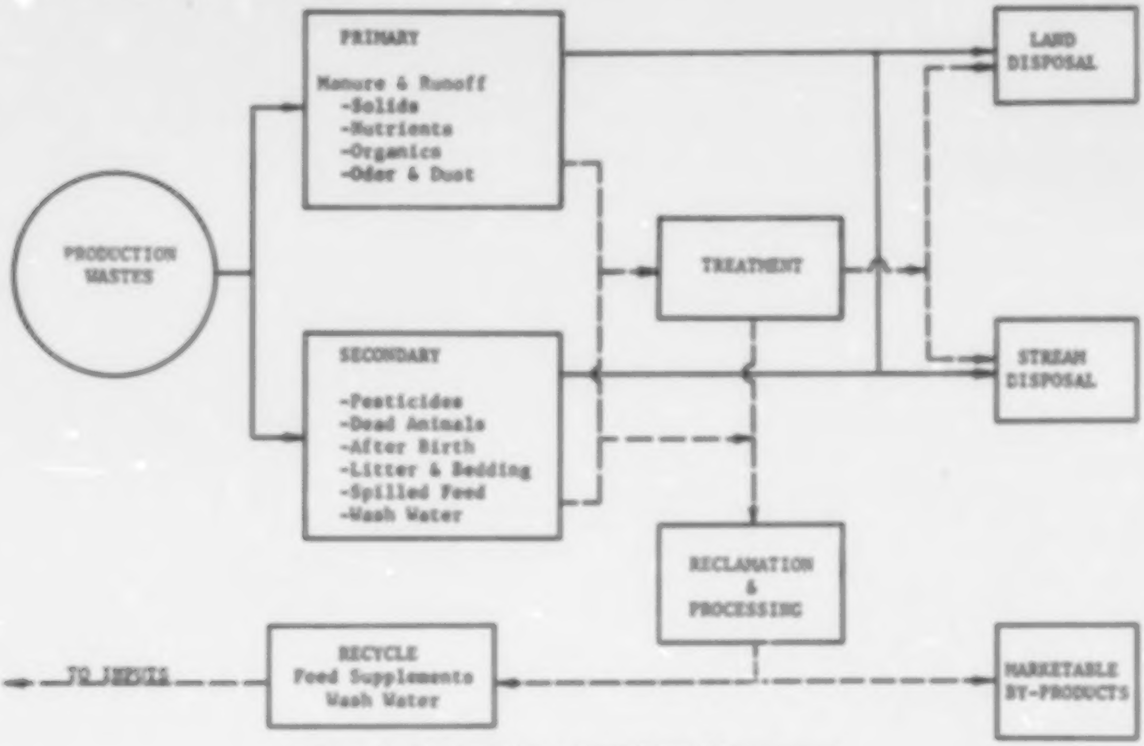

PRIMARY
Manure & Runoff
-Solids
-Nutrients
-Organics
-Odor & Dust
PRODUCTION WASTES
SECONDARY
-Pesticides
-Dead Animals
-After Birth
-Litter & Bedding
-Spilled Feed
-Wash Water
TREATMENT
LAND DISPOSAL
STREAM DISPOSAL
RECLAMATION & PROCESSING
RECYCLE
Feed Supplements
Wash Water
TO INPUTS
MARKETABLE BY-PRODUCTS

Figure 2: Blueprint for Animal Waste Management

Waste Management Activities and Water Pollution

Some appreciation for the significance and relationship of these waste management considerations to present production practices and impact on the aquatic environment may be explored by analyzing some of the results of recently completed research endeavors.

A primary impetus for the evolution of confined feeding is the expected improvement of efficiency in meat production.

The multiplicity of methods and systems by which this goal is achieved are far too numerous to cite. Nevertheless, small variations in certain of these methods or systems as they are implemented may prove particularly relevant from the standpoint of water quality even though production efficiency may show little change.

For example, Table 1 shows certain of the feed efficiency effects associated with functional variations in the operation or design of a beef cattle feedlot.

From this data, it is readily apparent that animal density has a very significant impact on the efficiency of "feeding out" a given animal as opposed to the other treatments evaluated.

The data also points to a "best" feed efficiency system for a feedlot designed for loose confinement, on a shallow slope, and without shading. When the constraint of environmental quality is considered, this conclusion may change, e.g., shading is useful in eliminating or reducing feedlot runoff or sloppy conditions

TABLE 1

MEAN FEEDLOT PERFORMANCE OF STEERS FOR CERTAIN TREATMENTS[1]
(POUNDS: 121 DAYS)

Parameter	Treatments		% Difference
	Surface Slope[1]		
	7.5%	*15%*	
Number of animals	36	36	
Daily gain	2.64	2.49	5.7
Feed consumption	20.94	20.50	2.1
Efficiency (feed/gain)	7.93	8.23	3.6
	Shading[1]		
	Covered	*Open*	
Number of animals	36	36	
Daily gain	2.57	2.56	
Feed consumption	20.79	20.65	
Efficiency (feed/gain)	8.09	8.07	
	Animal Density (square feet/animal)		
	30	*120*	
Number of animals	72	18	
Daily gain[2]	2.57	3.03	15.2
Feed consumption[3]	20.72	21.39	3.1
Efficiency (feed/gain)[2]	8.08	7.08	12.4

[1] No statistical treatment differences among parameters ($P < .05$).

[2] Statistically different ($P < .005$).

[3] Statistical difference at $P < .10$.

around feed bunks. Another vital management factor is the selection of an optimum feed regimen. Going beyond the need to use a feed composition best adapted to a given locale, as the operating and functional characteristics of a feedlot are concentrated, the waste management consequences of a given choice of feed become vitally important—particularly as these consequences integrate with other elements of a feeding complex.

As a point of departure, Table 2 shows representative waste production data relative to concentrate and roughage mix feed compositions.

Note particularly the wide disparity that was alluded to earlier with regard to manure accumulations associated with different feed inputs. These data serve to emphasize the massive physical problem of keeping cattle feedlots clean.

Further implications involving these differences in volume of manure generated may be gleaned from Tables 3 and 4. Of the multitude of factors which portend environmental "chaos," perhaps none are as graphic as those reflecting the water quality degradation associated with the runoff from feedlots as shown by these data. The runoff "slug" loads associated with the rainfall events carry effluents which are ten to several hundred times more concentrated than raw domestic sewage; with concentrations of solids and Chemical Oxygen Demand particularly related to feed composition. Winter conditions serve to compound the situation because freeze-thaw phenomena, and subsequent spring snowmelt leads to further

TABLE 2

EFFECTS OF FEED RATION COMPOSITION ON WASTE PRODUCTION[1]

Item:	All concentrate	12% Roughage
Number of animals	23	24
Feed dry matter, lb	60,768	77,110
Waste accumulation		
Total pounds	19,110	44,930
Dry matter, lb	8,982	21,072
Feedwaste ratio, D.M. basis	6.8:1	3.7:1
Square feet/animal	95	88
Live weight, lb	745	775
Daily dry matter waste accumulation		
Per head, lb	2.3	5.0
Per 100 lb live weight, lb	0.31	0.65

concentration of pollutants. Snowmelt runoff may even constitute a completely different waste management consideration from the viewpoint of control.

Thus, in spite of the many factors involved, any given animal or poultry producer may be confronted by a severe pollution problem that must be resolved. As noted in the introductory remarks, however, early attempts to eliminate or control these waste discharges were not always successful.

Land spreading is probably the method of choice for manure disposal where manure is collected and handled by bulk procedures. In spite of limited nutrient value compared to chemical fertilizer, manure disposal by land spreading can effect a measurable benefit to crop production and soil condition. Such a system is far from a panacea, however, because surface runoff from corn fields receiving beef cattle manure at rates which maximize crop yield may be heavily polluted even up to several months after manue is applied. Data given in Table 5 is illustraive of this circumstance.

TABLE 3

CONCENTRATIONS OF POLLUTANTS IN RUNOFF BY FEEDLOT SURFACE AND FEED COMPOSITION[1]

Date	pH	BOD (mg/l)	COD (mg/l)	NO_3-N (mg/l)	NH_3-N (mg/l)	ORG-N (mg/l)	ALKY (mg/l)
CONCRETE-CONCENTRATE							
8-24-69	6.0	7,355	28,929	1,270	340	610	1,030
8-26-69	5.90	8,900	38,400	280	395	302	1,584
CONCRETE-ROUGHAGE							
8-24-69	6.70	10,067	28,450	875	519	300	2,104
8-26-69	6.5	8,500	32,800	320	515	384	2,056
SOIL-ROUGHAGE							
8-24-69	7.8	1,758	8,280	103	79	200	1,238
8-26-69	7.40	1,010	2,964	24	77	25	928

The acute wate quality impact of these discharges is far from being as severe as any direct feedlot discharge. Over the course of one or several years, however, the chronic effects due to the icreased organic and nutrient inflow burden are likely to become apparent. It is precisely this insidious, diffuse level of pollution which is so difficult to evaluate or control. Similar results have been found when manure is either spread on pastureland or cattle or swine are grazed for forage. In these cases, for example, BOD may range as high as 150 mg/l, COD up to 400 mg/l, nitrogen to 40 mg/l and orthophosphate to 17 mg/l[6]. Since these are concentrations related to actual rainfall-runoff events, it is apparent that such

TABLE 4

RANGES OF RUNOFF CONCENTRATIONS FROM UNPAVED FEEDLOTS FOR SNOWMELT AND RAINFALL RUNOFF[3]

	Range of concentration	
Analysis	Winter runoff	Rainstorm runoff[1]
pH	6.7-7.6	6.7-9.4
Conductivity (millimhos/cm^2)	3.0-11.5	1.0-3.4
Total solids (%)	3.0-19.8	0.24-1.74
Volatile solids (%)	1.4-10.7	0.12-0.73
Ash (%)	1.5-9.2	0.12-1.05
COD (mg/l)	14,129-77,804	1300-8247
P (ppm)	6.8-753.2	13.9-46.6
NH_3-N (ppm)	670-2028	26-82
NO_3-N (ppm)	0-80	0-17
Total N (ppm)	1429-5765	65-555

[1] Concentrations for rainstorm-runoff are for the period April through June, 1969.

TABLE 5

QUALITY OF RUNOFF FROM CORN FIELD TREATED WITH MANURE AT 100 TONS PER ACRE[6]

	Parameter (mg/l)		
	COD	Nitrogen	Phosphorus
Prior to Manure	10-50	15.0	1.0
0-60 days After Manure	150-400	20-40	1.0-3.0

intermittent discharges are far from satisfactory from the standpoint achieving and maintaining stream quality standards.

Indiscriminate utilization of lagoons as a means for collecting, storing and stabilizing runoff has fostered additional problems. For many farm operations these structures represented a new level of sophistication in animal waste management. It is not at all difficult to visualize that many farmers thought that such structures, "at last had solved a problem." Unfortunately, however, the cards are actually heavily stacked against the likelihood that these structures are, by themselves, at all useful. The anatomy of this failure-prone system is briefly this: (1) the lagoons nearly always function anaerobically because engineering designs are based either on "rule of thumb" population equivalent specifications for organic waste loading, or on empirical hydrologic (storage) relationships both of which fail to properly account for the nature and level of waste flow inputs; (2) nutrients and non-degradable organic constitutents may actually be further concentrated by the storage functions; (3) odor and sludge removal and disposal problems are frequent, and (4) accidental overflow or design discharges from these lagoons are severely damaging to stream quality. Some specific data which buttresses the reasoning behind these conclusions is given in Tables 6 and 7. Of particular interest is the fact that these intermittent discharges may be likened to the occasions where municipal treatment plants by-pass raw wastes during storms. Nevertheless, the difference in water impact is quite dramatic when the quality of raw domestic waste is compared with the lagoon discharges as exemplified in Table 7.

There is a growing body of literature which indicates that the data given in the several tables above are not from a few isolated instances, but represent the conditions one may expect to encounter in a majority of cases where

TABLE 6

EFFLUENT QUALITY OF ANAEROBIC LAGOONS TREATING LIVESTOCK WASTE[7]

Livestock Waste	*Swine*	*Poultry*	*Beef*
pH	6.7-8.0	6.8-7.9	6.5-7.5
Total Solids (mg/l)	-	-	5900
Volatile Solids (mg/l)	850-2330	-	3710
Volatile Acids (mg/l)	72-528	-	400
Alkalinity (mg/l)	1120-2220	-	1400
BOD_5 (mg/l)	-	320-1350	1420
COD (mg/l)	940-3850	590-2550	5500
Total Nitrogen (mg/l)	-	113-290	500

TABLE 7

SUMMARY OF THE QUALITY OF EFFLUENT FROM ANAEROBIC LAGOONS FOR SWINE WASTES COMPARED WITH RAW DOMESTIC WASTE[4]

	Study Site			
Variable	A	B	C	Domestic
q (gal/day)	19.2	1.6	1.2	-
Hogs	300	100	90	-
BOD_5 (mg/l)	390	270	610	200-250
TOC (mg/l)	360	340	470	-
N (mg/l)	244	168	287	20-90
PO_4 (mg/l)	142	112	116	20-30
TS (mg/l)	2,000	1,500	1,500	200-1000

water pollution exists in agricultural areas. The control measures and management options that have been highlighted serve to emphasize the necessity for implementing and utilizing efficient total management schemes for feedlot operations.

Moreover, because the current waste management practices appear of value only in the short-term, these data provide a more than reasonable basis for pursuing research to find improved methods for controlling feedlot runoff. At this juncture, it appears likely that no classical biological treatment systems in and of themselves will provide a sufficiently efficient level of waste treatment. From the extreme magnitude of the waste flows presented earlier, it can be seen that even if biological systems achieve up to 90 percent removal of organic wastes, the effluent may still be stronger than raw domestic sewage. Additionally, the mass balance of nutrients will show little appreciable change in terms of "environmental safety" for watercourses. In either case, effluents from anaerobic lagoons, aerobic lagoons, oxidation ditches, activated sludge systems, or similar treatment measures will not conform to most existing water quality standards.

Thus, the Environmental Protection Agency research effort is being directed at developing and demonstrating an array of waste management procedures which effectively "close the loop" against waste discharges. In essence the effort is to aid and abet success in waste management for animal feeding operations by giving farmers the ability to institute and apply the concept of "Zero-Discharge" of waste flows.

Water Quality Standards and "Zero-Discharge" Guidelines

Such a goal as zero discharge may appear in the least to sound overly harsh and of questionable attainability. At best, however, this goal is one which potentially offers animal feeding operators the opportunity to the represent the epitome of exemplary performance in enhancing and protecting the quality of our environment. Since no industry is more dependent upon a pure water supply than agriculture, the agricultural operator will be engaging in notable self service.

We in EPA think it can be done. As will be indicated later, many of the mechanisms are already available. At this point, however, it would seem valuable to review briefly the water quality standards system, its nature and impact in relation to the no-discharge premise.

In 1965 Congress enacted the Water Quality Act of 1965, (P.L. 89-234) amending the Federal Water Pollution Control Act. Section 10, of the law provides for the States to establish standards of Water Quality which . . . "shall be such as to protect the public health or welfare and enhance the quality of water . . ." In establishing such standards, the State "shall take into consideration their use and value for public water supplies, propagation of fish and wildlife, recreation purposes, and agricultural, industrial and other legitimate uses."

The purposes of the standards are to:

a) provide an engineering base for the design of waste treatment works by municipalities and industries without uncertainties in waste disposal requirements in interstate waters.

b) serve as a clear public (local) policy statement on the use or uses to which specific segments of interstate waters may be put after due consideration of all the factors delineated above.

The Act encouraged the States to develop their own criteria for the water quality standards applicable to their interstate waters. The Act also provided that the States must submit a plan for implementing and enforcing the water quality criteria, including time schedules, controls to be utilized, a surveillance system for measuring compliance, and the enforcement authority for ensuring compliance.

Guidelines subsequently developed by the Federal Water Pollution Control Administration (FWPCA) for establishing these water quality standards indicated that no standard would be approved which permitted a treatable waste to be discharged into any interstate water without first having received the ". . . best practicable treatment or control . . ." or at least a degree of treatment which is commensurate with the purposes of the Act, hearings were conducted to provide for the integration, of the views of all interest groups, and industrial, municipal, agricultural and governmental spokesmen. For the most part, all of the States now have approved standards.

Several general elements which characterize current standards are important to feedlot operators. First, and perhaps foremost, most standards do not specifically reflect agricultural needs or impact per se. Broad estimates were made, but the standards evolved primarily from readily available data on industrial and municipal waste discharges and related statistics. Other factors generally encountered in the State laws include: (1) lack of stipulation of the degree of treatment, per se, that each waste contributor is to provide with reference only to the quality of the stream and the uses reserved for that stream or stretch of stream, (2) except in certain instances such as with detergents, nutrients are not always specifically delineated, and (3) numerous constraints may be placed upon such parameters as suspended material or organic wastes particularly with regard to subsequent use or degradation of existing quality.

These characteristics perhaps serve to promote confusion on the part of animal feeders. Nevertheless, feedlot operators are no less responsible for compliance with the State laws than are any other industry or municipality. However, when one considers the fact of the existence of the standards, the various levels of pollutants in watercourses which the standards prescribe, the nature of treated or untreated wastes which may emanate from a feeding complex, the wisdom of a zero discharge philosophy becomes somewhat more acceptable.

An estimate of the relationship of feedlot runoff pollution to municipal pollution on a National basis as shown in Figure 3 can be used as a foundation upon which to elaborate on the "zero-discharge" concept. This diagram shows feedlot runoff pollution as Biochemical Oxygen Demand (BOD) superimposed on the current, projected municipal waste load. These curves have been derived with existing control legislation in mind, as well as projected population growth and so forth. The feedlot runoff curves are conservatively based upon the assumptions: (1) historical industry growth trends will continue at the current rate; (2) since all animal wastes do not have the potential for reaching streams, a weighted average baseline BOD for all animals and poultry will represent a reasonable estimate of runoff quality; (3) of all wastes generated, only 1.0 to 5.0 percent will reach watercourses in some form of waste flow (i.e., treated or untreated).

The animal waste curves may not withstand knowledgeable scrutiny. Nonetheless, they serve to properly illustrate an important point. If one makes what now appears to be safe presumptions that tertiary treatment of municipal wastes will ultimately be required and instituted, and that "heavy" industry will be providing a similar high degree of waste treatment, the single remaining high organic waste source is from agricultural (mainly animal) sources in which problem area the control technology is far from equal to that available to satisfy industrial and municipal requirements.

The stringency of the situation thus depicted, is further amplified by the recently instituted Federal program governing industrial waste discharge permits, as stipulated in Executive Order Number 11574. This program, administered by the Corps of Engineers with technical consultation by EPA, provides for the inclusion of large animal and poultry operations in the permit program. The specific guidelines governing feedlot permits will vary slightly from region to region within the country. A general appreciation of the nature of the guidelines can be gained, however, by noting the requirements shown in Figure 4 which are being instituted for feedlots in the lower Missouri Basin Region, comprised of Iowa, Nebraska, Kansas and Missouri. For the purposes of this discussion, the permit program is most significant in that it establishes the basis for obtaining detailed data on waste discharges from feedlots and the prescription of effluent quality discharge guidelines, or more succinctly, effluent standards, and it provides for incorporating navigable streams into the national water quality management complex.

It is, therefore, now apparent that the legal and institutional constraints now confronting feedlot operators almost "force" the issue toward zero-discharge waste management. But bear in mind that "zero-discharge" is really a means to an end in complying with water quality standards, and that absolute closed waste management concepts may not be necessary; although, such concepts may prove to be the ultimate, long-term solution within the industry. Instead, however, the need is to provide for a zero-discharge of only those waste flows which are likely to cause an adverse impact on water quality. That is, *direct* discharges from feedlots, retention basins, or anaerobic lagoons would be unsatisfactory; whereas, the recycle of the discharges by irrigation on cropland with attendant soil and water conservation, would provide enough final treatment so that any subsequent runoff would not be injurious. An operational system of this type is now being demonstrated and evaluated by EPA at McKinney, Texas, where a so-called "spray-runoff" concept is used to treat wastes from a 10,000 head beef cattle feedlot.

In this case, the feedlot runoff traverses a system of ponds, drainage ditch and retention basin, from where it is irrigated onto field plots of Canary Grass. The upper root zone in the grassed plots serves as a very efficient soil-microbial filter. As the irrigated wastes flow over the soil surface, this grass and soil "bio-filter" serves to virtually eliminate all but residual amount of organic and nutrient pollutants. Final runoff from the plots is sufficiently treated to allow direct discharge to a downstream reservoir whereas, the quality of the influent to the spray-runoff plots was found to

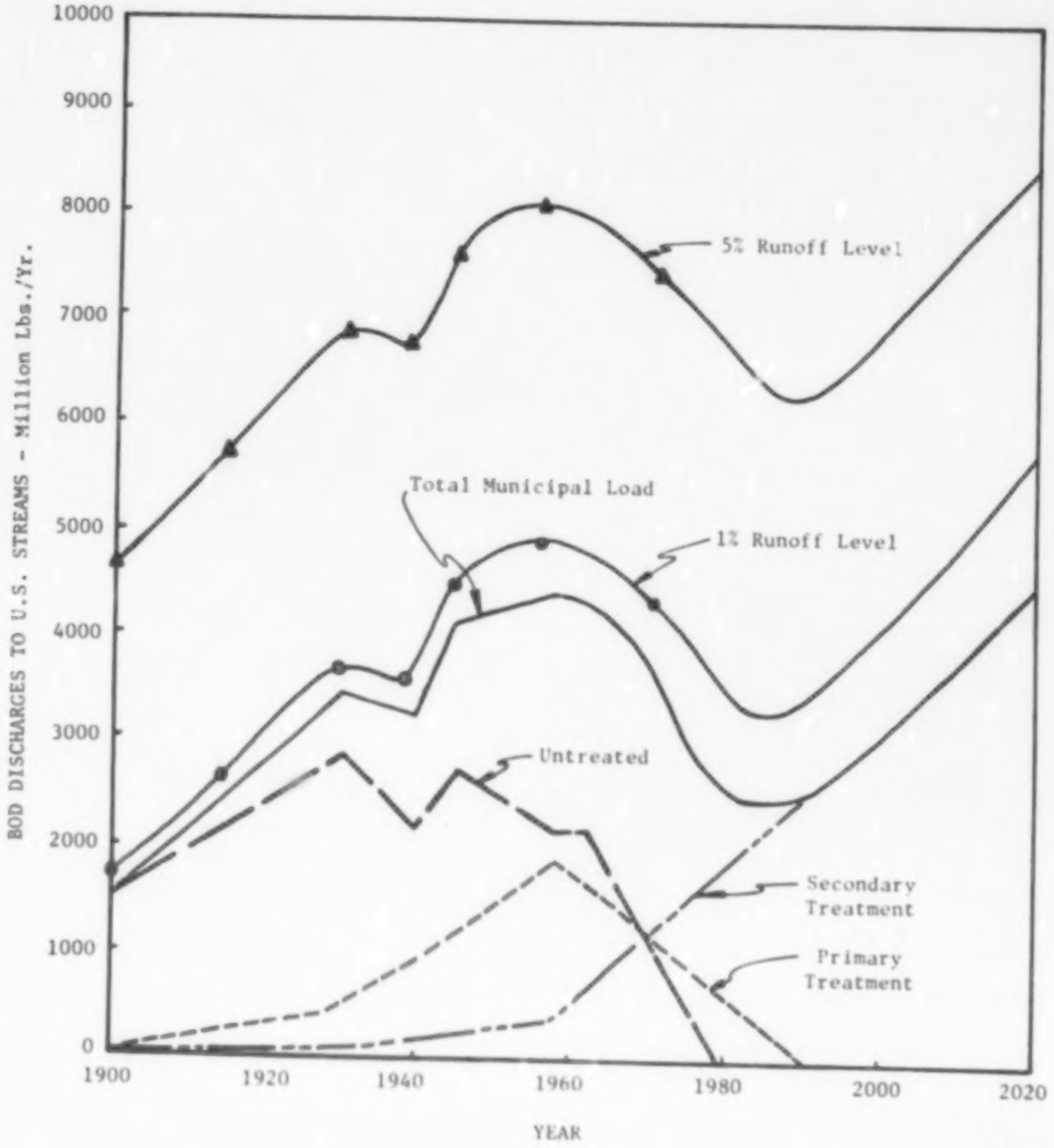


Figure 3: Estimate of BOD Discharges to U.S. Streams

EFFLUENT DISCHARGE GUIDELINES

(1) Permits now apply to operations of 1000 animal units and larger.

- 1 animal unit is equivalent to average BOD of waste from 1 beef animal
- 1000 animal units is equal to 700 dairy cows, 4500 hogs for slaughter 290,000 broilers, etc.

(2) "Discharge" is from:

- a man-made drainage, flushing or collection system regularly discharging waterborne wastes to a navigable stream or tributary (*irrespective* of precipitation);
- wastes are directly placed into a stream which traverses the feedlot;
- frequent overflow of containment or retention facility

(3) Decentralized facilities will be treated on an individual basis as to the 1000 AU criteria and discharge, except where separate facilities under one ownerships have a common waste discharge point.

Figure 4: Outline of Guideline Permits for Waste Discharges from Animal Feedlots

be quite toxic to the reservoir ecosystem. In fact, an accidental discharge of the partially stabilized waste caused a serious fish kill and subsequently resulted in the present project.

A somewhat different system for poultry wastes (Figure 5) has been demonstrated on a pilot scale. In this case, the waste source (chickens) are caged in such a manner as to be suspended above an oxidation ditch. The ditch essentially operates as a closed unit, but provisions for land disposal of effluent may readily be made if and when the need may arise.

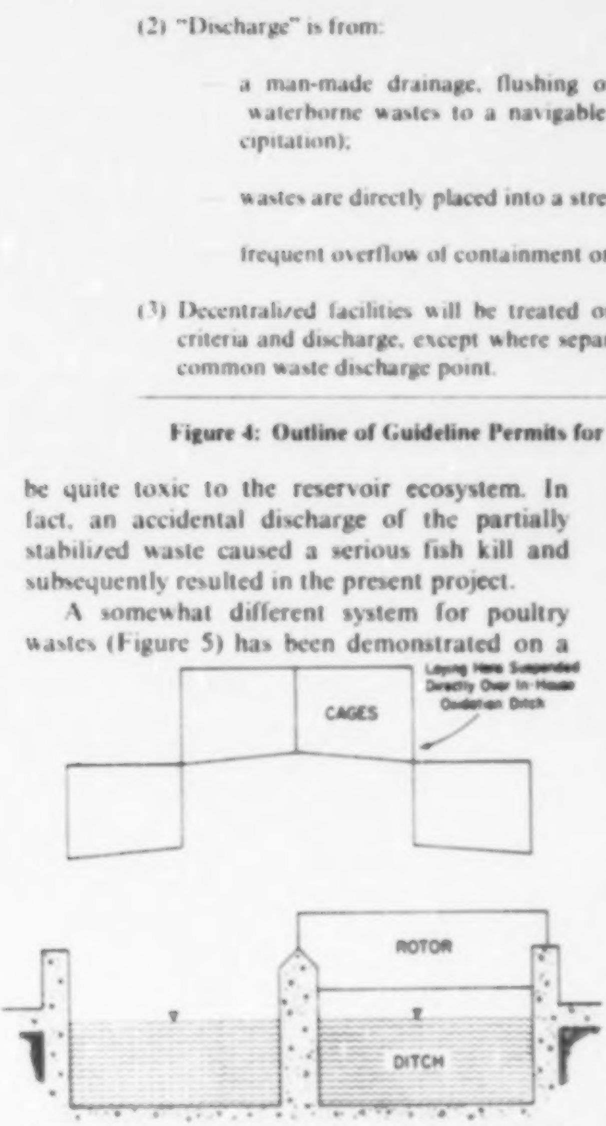

Laying Hens Suspended Directly Over In-House Oxidation Ditch
CAGES
ROTOR
DITCH

Figure 5: Cross-Sectional View of Oxidation Ditch for Poultry Wastes

Another concept which appears promising also involves the use of the oxidation ditch as the principal treatment process in managing swing wastes. This system, shown in Figure 6, takes full advantage of the zero-discharge concept. With the exception of infrequent drawdown of solids for field disposal, or potential periodic overflow of the treated liquid effluent, the treatment plant is totally self-contained.

In both of these projects involving the oxidation ditch, the wastes, which are either directly dropped or pumped into the ditch, serve as substrate for microbial degradation. The waste water slurry is mixed, and oxygenated by a mechanical surface aerator. With proper design, completely aerobic and odorless operation is possible; with proper management oxygen demanding material, solids, and nutrients such as nitrogen, can be removed to a large degree such that recycle to the land can be accomplished with minimal pollution hazard. Research is progressing to establish commercial scale design and operation criteria. This work will resolve uncertainties in managing these facilities in such a manner that treatment efficiency will be recorded not as a level of pollu-

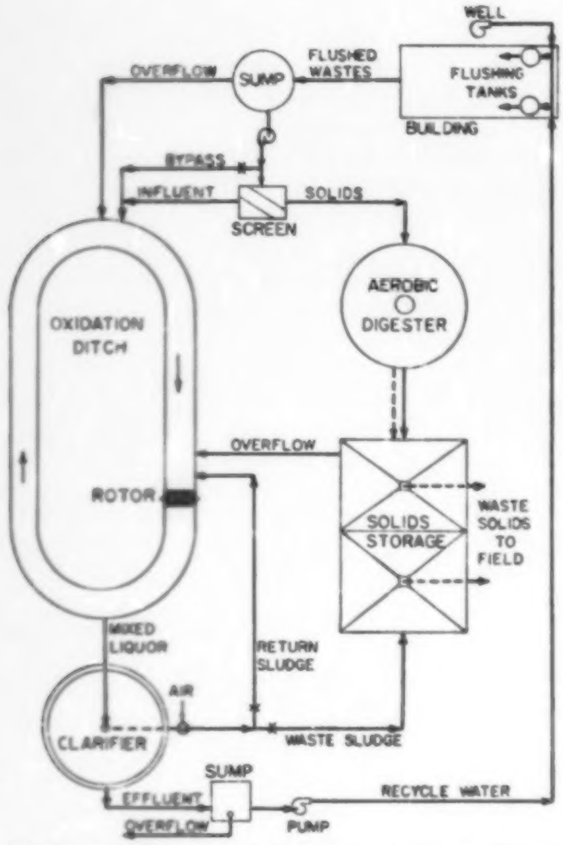

WELL
FLUSHED WASTES
OVERFLOW
SUMP
FLUSHING TANKS
BUILDING
BYPASS
INFLUENT
SOLIDS
SCREEN
AEROBIC DIGESTER
OXIDATION DITCH
OVERFLOW
ROTOR
SOLIDS STORAGE
WASTE SOLIDS TO FIELD
MIXED LIQUOR
RETURN SLUDGE
AIR
CLARIFIER
WASTE SLUDGE
SUMP
RECYCLE WATER
EFFLUENT
OVERFLOW
PUMP

Figure 6: Schematic of Closed Loop Waste Treatment System for Swine Wastes Utilizing an Oxidation Ditch

tant reduction, but as a percentage of success in achieving a zero discharge to the environment.

Another concept which shows great promise in providing inexpensive, highly efficient waste control is the "barriered landscape water renovation system (BLWRS)". This system (Figure 7) is a refinement of the use of the soil complex as a unit process for achieving tertiary (95 percent plus) levels of waste treatment. The BLWRS involves the modification of the soil by constructing a bench terrace type of structure. Limestone or slag is added to the upper portion of the structure to serve as a chemical adsorber for phosphorus. The lower (downhill) portion of the terrace is designed to function as an anaerobic zone to provide denitrification. Preliminary data shows overall organic and nutrient removal efficiencies of 98 percent and greater when the BLWRS is used to polish effluent from anaerobic lagoons.

COMMENTS IN OVERVIEW

The foregoing represent but a few examples of means that feedlot operators, particularly those who manage a "family farm" complex, may utilize in eliminating waste discharges. A considerable number of other options exist, ranging from well managed land spreading methods to composting and complete treatment. For the massive beef cattle operations, the options may not be as varied or flexible. It is quite possible that such measures that involve highly sophisticated methods for waste recycle, refeeding and reuse, or conversion and by-product recovery represent the best potential long-term solution. At this time, however, the feasibility of some of these methods seems rather tenuous and a great more development work is required.

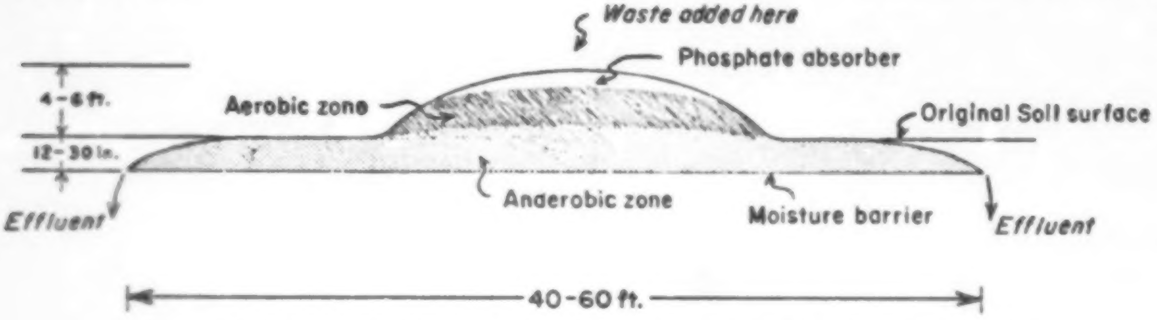

Waste added here
Phosphate absorber
4-6 ft.
Aerobic zone
Original Soil surface
12-30 in.
Effluent
Anaerobic zone
Moisture barrier
Effluent
40-60 ft.

Figure 7: Schematic Cross Section of Barriered Landscape Water Renovation System[10]

The waste management measures cited above represent alternatives for but one factor within the total production management matrix confronting feedlot operators. By way of summarizing this discussion, some of the key elements of this matrix should be given proper perspective.

The industry itself is dictating the current trend toward larger, automated, high production feeding complexes, and not without sound reasoning. For example, in the case of cattle feeding, even though the initial capital costs of an open, earth surface feedlot would be only about 25 percent of those required for a total housed confinement facility, there is likely to be sufficient economic payoff to justify the latter style of facility. First, feeding efficiency is enhanced by an average of 10 to 12 percent since the animals are not working against muddy surfaces and other environmental factors. Second, the typical large open feedlot must employ several people and expensive equipment in keeping the feeding pens clean, whereas, the housed facility may have slotted floors and manure scrapers thus eliminating the need for this labor and equipment. Third, automated feeding systems in housed facilities help to further reduce labor and feed handling costs associated with open (more widely dispersed) feeding pens. Fourth, housing provides numerous attendant benefits such as odor control, improved animal health, and simplified requirements for monitoring and maintaining nutritional quality control. Finally, the housing facility provides undeniable relief from most of the problems related to runoff from the feedlot, and nearly all of the factors which impact runoff quality such as choice of feed ration, sloping or paving lots, and constructing and maintaining interceptor ditches and other runoff control measures. The most critical step in closing the loop against feedlot runoff pollution has been taken.

All of these factors integrate with the increasingly stringent legal requirements to bear directly on the ability and need to utilize and implement zero-discharge controls on animal wastes.

Admittedly, the present character of the feeding industry is hardly amendable to overnight shifts toward complete housed operations. There are tens of thousands of small feeding facilities, for which the operator does not have the capital for the type of expansion and modernization being contemplated here.

Nevertheless, except for variation in scale or degree, the same problems confronting large operations also confront small ones; the management science and technology necessary to allow small operations to exist both as viable competitors among peers, and as an enhancement rather than detriment to the environment, is already available, and must be adopted.

In the final analysis, economic incentives to intensify production and social pressures to improve the environment will be paramount considerations as the character of the industry evolves.

The need to structure educational programs, institutional and cultural arrangements, and research endeavors to provide for the eventuality of "animal hotels" and for stringent standards for water quality is now an apparent fact of life.

REFERENCES

1. Midwest Research Institute, 1971 "The Pollution Potential of the Confined Livestock Feeding Industry", Final Report, Environmental Protection Agency.

2. Texas Tech University, 1971 "Characteristics of Wastes from Southwestern Cattle Feedlots", Report 13040 DEM 07/70, Environmental Protection Agency.

3. Gilbertson, C. B., T. M. McCalla, et al., "The Effect of Animal Density and Surface Slope on Characteristics of Runoff, Solid Wastes and Nitrate Movement on Unpaved Beef Feedlots", Bull. SB 508, University of Nebraska.

4. North Carolina State University, 1971 "Role of Animal Wastes in Agricultural Land Runoff", Report 13020 DGX 06/71, Environmental Protection Agency.

5. Meat Producers, Inc. 1970 "Soil Treatment of Cattle Feedlot Runoff", Project Number 13040 FWB, Robert S. Kerr Water Research Center, Environmental Protection Agency.

6. Kansas State University, 1971 "Demonstration and Development of Facilities for Treatment and Ultimate Disposal of Cattle Feedlot Waste", Interim Report, Project Number 13040 DAT, Environmental Protection Agency.

7. Loehr, R. C., 1968 "Pollution Implications of Animal Wastes — A Forward Oriented

Review", U.S. Department of the Interior (FWPCA – now Environmental Protection Agency).

8. Loehr, R. C., D. F. Anderson and A. C. Anthonisen, 1971 "An Oxidation Ditch for the Handling and Treatment of Poultry Wastes", presented at the International Symposium on Livestock Wastes, Columbus, Ohio.

9. Ohio State University, 1971 "Automated System for Water Pollution Control from an Animal Production Unit", Interim Report, Project Number 13040 EOL, Environmental Protection Agency.

10. Michigan State University, 1971 "Soil Modification for the Denitrification and Phosphate Reduction of Feedlot Waste", Interim Report, Project Number 13040 FYK, Environmental Protection Agency.

STATUS OF DAIRY CATTLE WASTE TREATMENT AND MANAGEMENT RESEARCH

A. C. DALE, PROFESSOR

Department of Agricultural Engineering
Purdue University
Lafayette, Indiana 47907

INTRODUCTION

The production of dairy products has not kept pace with other agricultural production in the United States. Nevertheless such products still constitute a large proportion of our food supply. New and improved dairy products are continually being manufactured and processed from the raw milk. One of the latest for example that is now being widely accepted and consumed is yogurt. Thus, with the ingenuity of the researcher, we shall no doubt continue to have milk converted into many products that are widely accepted and used. Although the per capita consumption of fluid milk as such may continue to decrease the total consumption of dairy products will continue to increase.

Dairy Production Systems and Sizes

Two milking systems in dairy production have been followed for many years. These are (1) the stanchion barn where each individul cow of the entire herd is tied and (2) the milking "parlor" in which only a small percentage of the herd is confined temporarily while milking. In the second system, feeding is done outside or in another building.

The Stanchion Barn System

The stanchion barn system is the oldest accepted method for managing dairy cattle. The barn which is generally sufficient in size to contain the entire milking herd is the basic unit. Typically it consists of one or more rows of tie-stalls and feed bunks. The cows are tied side by side usually on a slightly raised (3" to 6") platform with their heads protruding through a slot or chain tie into the feed bunk. Enough flexibility is provided in the tie system to permit the cows to lie down and stand up. The platform may or may not be bedded with some soft materials such as straw, sawdust, etc.

A gutter about 14–18 inches wide and 4 to 8 inches deep is usually built in immediately behind the cows to catch the excrement. Between this gutter and the gutter for a second row of cows on the other side is a walk way or alley for the men performing the milking. Feeding is usually done either mechanically or by hand from the front of the manger.

The procedure for handling the cows may differ between dairies. However in very cold weather the cows are often held in the stanchion barn the entire 24 hours. In warm weather the operation varies but the majority probably keep

Preceding page blank

the cattle in over night and turn them out to pasture in the day. Others may let them out into a large loafing barn or feeding floor where the cows have access to various feed rations.

Milking Parlor-Free Stall System

The milking parlor system came into existence in the latter 1930s. Briefly it consists of (1) an area (building) where only a small portion (5-15%) of the dairy cows are prepared and milked at a time and (2) an area where the cows are fed and rest between milkings. The milking area consists of a platform raised some 30" to 36" on which the cows stand during the milking process. The workmen stand down in the "pit" where it is easy to reach the udder for cleaning and milking.

In both systems described above, milking is typically performed by mechanical milking machines. The milk is pumped through pipelines to a cooled, bulk storage tank in the milk house. Milk is "picked up" every two or three days by a tank truck for delivery to the processing plant.

Trends in Dairy Production Systems

The changes which have taken place in dairy production have evolved over a long period of time. Summer pasture, considered a must some 30 to 35 years ago, has essentially disappeared. Almost all feed is now processed or partially processed and brought to the cow. Areas for the cattle to "roam" over are becoming smaller. Shelter for all cows of the dairy are available on most dairy farms. However, there are still many dairymen who like to turn the cows out onto a soft pasture for grazing, exercising and rest. Paved uncovered feed floors are also in existence on many of the dairy farms. In these areas the cattle are fed and permitted to loaf between milking. In a way there is a duplication of areas for most of the cows. The general trend in dairy cow management within the last 15 years has been toward more confined (uncovered feedlots, free-stall barns, etc.) cows with the elimination of the large pasture areas. Recently the trend has been toward confinement in completely covered areas. Both feeding and loafing are often included under the same roof.

Sizes of dairy production systems have also continually increased. This has been in both the number of animals milked and in the quantity of milk produced by each. The six to twenty cow, low producing (8,000 lbs/cow/year) herds are almost extinct. However, the majority of the dairy herds are still under the fifty size (see Table I) but their production has increased to 12,000 to 15,000 lbs/yr. There are a large number of herds in the 50 to 100 group (Approx. 25%) and a small number (5-8%) in the range of 100 to 300 cow-herds. A widely scattered group of operators may be found that milk as many as 1,000 or more cows. However, it is estimated that 60 percent of the milk production is still from the 20 to 100 cow herds. One-third of the remaining 40% comes from herds of 100 head and more. The remaining 26% comes from the under 20 cow dairy producer. Table I shows the 1964 census of the U.S. on the above. Table II shows the dairy herd sizes in Indiana as reported by the 1970 census. Table III summarizes the large herds in the U.S. in 1964.

TABLE I

DAIRY HERD SIZES IN U.S.
1964 CENSUS

Size of Herd	*Percent of Total*
Less than 20	28.6
20-49	43.9
50-99	16.3
100 or more	11.2

Predictions for the future are that dairy herd sizes will continue upward in numbers with a further increase in the quantity of production per cow. As to where the average size herd will evolve is only a guess but economical units will probably dictate that the number move up in the 75 to 125 cow herd size. Estimates have been made that by 1985 the dairy herd size in New York State will average approximately 80 cows.

Also it appears that in the dairy production system of the future, most herds are going to be housed in covered areas. At least this is the trend in several areas including some of the hot, dry areas where protection from the sun and

TABLE II

DAIRY HERD SIZES IN INDIANA 1969 CENSUS

Size of Herd	*No. of Farms*	*No. of Cows*	*Percent*
Less than 20	6,651	51,246	23.3
20-49	3,609	110,454	50.1
50-99	810	50,231	22.7
100 or more	66	8,770	3.9
Avg. is 20	11,136	220,701	100.0

TABLE III

DAIRY COWS ON FARMS IN U.S. 1964 CENSUS

State	*Number farms with 100 or more*	*100-200*	*Over 200*
1. California	2,601	1,505	1,096
2. Texas	692	556	136
3. New York	576	526	50
4. Florida	381	146	235
5. Alabama	311	250	61
6. Georgia	251	213	38
7. Louisiana	235	201	34
8. Wisconsin	228	208	20
9. Washington	224	181	43
10. Virginia	210	186	24
Total	5,709	3,972	1,737

The 200 and over herd represent 5.3% of all dairy cows.
The 100-199 dairies represent 5.9% of all dairy cows.
88.2% of the U.S. Dairy cows exist on farms with herds of 100 or less.

heat may be necessary. Needless to mention is the desirability of complete coverage for cows in the extremely cold climates. Also influencing the trend in this direction is the management of the wastes and the control of runoff that may carry pollutional materials with it.

Dairy Waste Management Problems

Although it may be somewhat presumptious on the writer's part, it appears that the dairyman has done a relatively good job of controlling the diary cow's wastes. Perhaps this was of necessity since sanitarians often visited the premises to observe the operation. Also certain guidelines had been set up to be followed regarding such an operation, e.g. manure storages were to be fly proof, manure could not be stored longer than a given period, etc. In addition, operations have been on the small side, therefore sufficient land was available to absorb the nutrients and organic matter without it becoming overloaded or polluted. Also the dairyman has rather diligently followed the process of returning the wastes to the soil in order to improve crop production for feed for the cows.

Even with the normal smallness of the dairy operation, the above does not apply to all present operations or to possible future operations. In the Riverside and Ontario, California areas for example, dairies much larger than average exist on 40 to 50 acre plots of land. However, this is unique as most dairy farms in other areas have some three to four or possibly more acres of land per dairy cow. But with the small acreages of the dairies around Riverside and Ontario, a problem of considerable magnitude already exists because of the large dairy herds are producing more wastes than may be readily applied to the surrounding soils.

To increase the size of the dairy operation to one that is more economically feasible is the goal of most producers. However the problem of what to do with the wastes is one of the "bottle necks" that has not been completely answered. It presents difficulties beyond what the operators were confronted with as a small producers. However until dairies do increase to a much larger size (4 to 6 times) than presently indicated, land generally will be available for reception of the wastes.

Control of runoff from the feed floors has confronted the dairyman with the uncovered operation. With the large uncovered paved area, he must control the large volumes of water containing organic matter and nutrients not normally associated with small operations. There he may have to go to some method of managing the wastes to which he has not been accustomed.

As with most businesses, economics plays an important place in the dairy operation. The treatment and disposal of waste materials are particularly vulnerable on this point. The wastes have relatively low economic value, are difficult and messy to handle, and produce odors that are objectionable.

RESEARCH ON TREATMENT AND MANAGEMENT OF DAIRY COW WASTES

Dairy cattle wastes are not entirely unique as contrasted to other farm animal wastes, but they do differ in a number of ways.

Raw Wastes

The general nature of animal wastes has been described by Morrison (31): "The feces of farm animals consist chiefly of undigested food that has never really been within the body proper. This undigested food is mostly cellulose or fiber, which has escaped bacterial action. A portion of the other nutrients usually escape digestion. This may be due to insufficient chewing of such foods as seeds or because some nutrients are protected from the digestive juices through being enclosed in resistant cell walls of cellulose.

In addition to undigested food the feces also contain residue from the digestive fluids, waste mineral matter, worn-out cells from the intestinal linings, mucus, and bacteria. They may also contain such foreign matter as dirt consumed along with the food."

Manure as defecated by the dairy cow is affected by the ration which has been fed. This contributes to the main difference between their fecal matter and that of most other farm animals. For example, their ration usually contains a large portion of long or ground hay, silage or other roughages. This large quantity of roughage, as it is normally called, seems to be necessary, although a large portion may never be utilized except as "filler" for the ruminant. The succulent and easily digestable portion is utilized by the ruminant but a large portion (stems, stalks, broken and unbroken grains, fibers, etc.) passes on through the digestive system with little change. In a waste treatment plant with a digester this material would be classified as "non-degradable". Although a number of experiments have been performed by researchers, every ration is different, so all results vary and do not agree. In round figures, it appears that some fifty to sixty percent of the manure from dairy cattle is in the non-biodegradable classification. Therefore any plant designed for the treatment of such wastes must take this into consideration. Table IV gives some average physical properties of dairy cattle wastes found by Dale (13).

Table V gives some chemical properties of dairy cattle manure.

Returning Manures to the Soil

Much of the research in progress on the treatment and disposal of dairy cow manure involves the return of the raw or stabilized

TABLE IV

SOME PROPERTIES OF DAIRY CATTLE MANURE

Average daily manure production	107.8 lbs
Portion of manure as feces	68.8 percent
Portion of manure as urine	31.2 percent
Percent body weight	7.22 percent
Moisture content of feces	82.7 percent
Moisture content of urine	95.1 percent
Average moisture content of manure	87.5 percent
Dry matter in feces	12.83 lb
Dry matter in urine	1.08 lb
Fixed solids in feces	13.8 percent
Fixed solids in urine	37.6 percent
BOD of straight manure (urine plus feces)	25,600 ppm
BOD per day	2.76 lb

TABLE V

CHEMICAL CONTENTS OF DAIRY CATTLE MANURE

	lbs/ton Manure								
Moisture Content	*N*	*P*	*K*	*S*	Ca	Fe	Mg	U.S.	Fat
79%	11.2	2.0	10.2	1.0	5.6	0.08	2.2	322	7

wastes to the soil In a way it appears that most researchers agre that the soil is the only acceptable place for these wastes. When one considers that most of the wastes came from the soil, he can hardy disagree. The main question or problem seem to be "How much and in what manner can the wastes be returned to a given area of land without polluting it?"

Research at the University of Wisconsin indicates that cow manure may be spread on land until approximately 200 to 300 pounds of total nitrogen has been applied per acre. By using such crops as Reed's Canary grass, more may be applied as this crop will remove some 300-400 pounds of nitrogen per acre's production.

In the process of returning manures to the land it appears that much nitrogen is lost by ammoniafication with possibly some denitrification occurring. Typically it has been found that the loss of nitrogen by these methods often approaches fifty percent. Thus more manure may be placed on the soil, based on the nitrogen available, than would be indicated by a direct production computation.

Solid Collection and Spreading

The scraping of solid or semi-solid cow excreta into piles, loading in a mechanical manure spreader by a front-end loader on a tractor, and spreading on nearby soil, is still the most accepted way of handling dairy cow manure. Why is this? It comes down to about two reasons (1) it is relatively economical and (2) it is accepted by sanitarians. Sanitarians have not generally accepted some of the different or new schemes of managing dairy cattle manure. Included in these are the oxidation ditch and aerated lagoon. Of course this may be correct as neither have proved themselves completely.

Liquid Collection and Spreading

Liquid handling of farm animal waste came into this field some fifteen to eighteen years ago. It has been highly successful in the handling of swine wastes and somewhat less successful in poultry, dairy and beef operations.

Collection.

The collection of wastes in the semi-liquid form is necessary for the liquid handling system to operate successfully. The present dairy operation has not been easily adaptable to this method. For example, feedfloor outside resulted in too much water at times of moderate rainfall and a lack of water during dry periods or in dry areas. Neither was the loafing barn adaptable to the system since bedding of various kinds was desirable and these materials soaked up the liquids. Thus the liquid or semi-liquid system was not readily acceptable at first to the dairy farmer or easily adaptable to his system.

However the trend toward free-stall barns and completely covered feeding areas is apparently changing the adaptability of the liquid manure handling system to the dairy operation. In this system all liquids are conserved along with the fecal matter and only a small amount of additional water is needed to give an operable system.

Liquid Spreading or Soil Injection.

In the liquid system the collected manure is returned to the soil by either spreading a thin layer on the surface or injecting it into the soil (plowed under or injected about 6 to 10" under the surface). Although either system works satisfactorily from the handling mechanisms, the spraying on top of the surface has two objectionable features; (1) the material remains on top of the soil where it may be readily washed off by rain or melting snow, and (2) odors accompanying the spray are often highly objectionable. The injection method improves on both of these points but it too has a problem in that the soil needs to be in a workable condition for proper application. Thus during the winter, wet weather or when crops are on the soil this system is stymied. In either system the applicator must watch the quantity that is being applied.

Aerated Wastes and Aerobic Decomposition

Aeration of whole dairy cattle manure can only partially stabilize it even over long periods of time. The readily usable or degradable substrate is used rapidly by the aerobic culture. However the slowly degradable material resists use by the culture over a very long period of time. Some dairy wastes aerated for approximately 182 days by the author still contained about 75 percent volatile solids in the dry matter. Left unaerated, the material goes septic and produces odors. Figure 1 shows the percent reduction of volatile solids aerated for 182 days. Diluted but unstrained manure was used. Degradation proceeded slowly after the first few weeks.

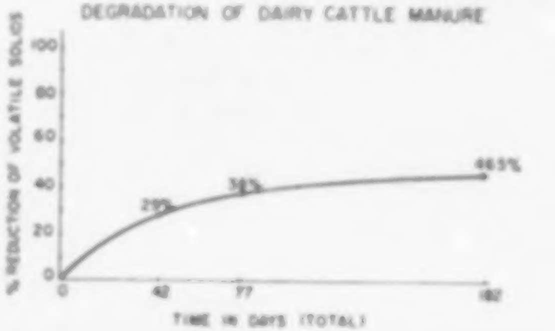


Figure 1: Aerobic Decomposition of Whole Dairy Cattle Manure

The main accomplishment of aeration of dairy cow manure appears to be the control of odor. A secondary factor may be the maintenance of a well mixed solid and liquid mixture that can be handled more easily than the normal manure.

Table VI gives an analysis of some dairy cattle manures that had been aerated for 24 weeks.

Dale (14) and his colleagues have made a number of studies on the aerobic decomposition of dairy cattle manure. In one phase of the study, Nye, Dale, and Bloodgood (34) found that temperature had a marked effect on the rate of decomposition as shown in figure 2. The manure used in this study was finely ground to eliminate large particle size as a factor. At 40 F, only about thirty-five percent of the volatile solids were degraded after 60 days extended aeration. Whereas at 75 F, about 75 percent of the volatile solids were degraded. The degradation of the manure was much better in the finely ground condition than as whole wastes as found by Dale (13) in an earlier experiment.

TABLE VI

ANALYSIS OF SETTLE SLUDGE AFTER 24 WEEKS AERATION

Percent added daily for 11 weeks	*Dry matter, percent*	*Ash, percent*	*N, percent*	*P, percent*	*K, percent*
1	8.0	25.6	2.65	0.92	1.18
2	7.7	22.5	2.39	0.96	1.93
2 unstrained	8.0	20.0	2.69	0.90	1.27
3	7.2	16.6	2.09	0.81	0.50
4	8.0	18.3	2.06	0.73	1.00

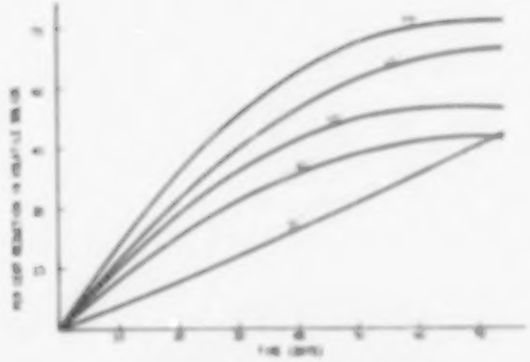


Figure 2: Aerobic Decomposition of Ground Dairy Cattle Manure

Anaerobically Digested Wastes

Residue from anaerobically digested wastes from dairy cattle is similar to that from aerobically treated wastes. Much of the carbon, hydrogen and oxygen will be removed from the soluble portion in the form of methane and carbon dioxide. However large fibers and particles remain almost unaffected. Thus much organic material remains along with many of the minerals. Even a final "polishing" by aeration does not remove the relatively stable or nonbiodegradable organic matter. The BOD5 can be greatly reduced and it may be sufficiently low for normally accepted discharge into natural streams. However, since there will be a continual build up of the solids and nutrients, it is not considered advisable.

In some laboratory experiments by Halderson six cubic feet of methane have been collected per pound of volatile solid decomposed. But again much non-degradable solids were left that would in the case of an actual operation have to be disposed of in some manner. Jefferies also found that the BOD and COD could be greatly reduced by anaerobic treatment.

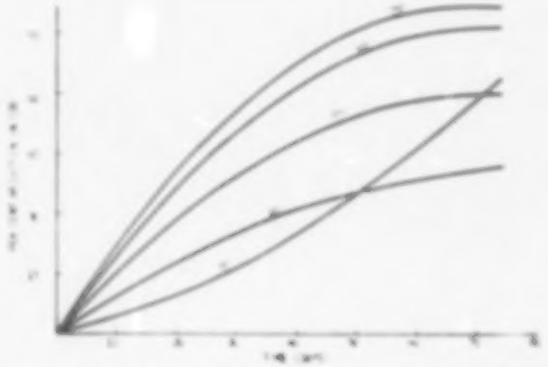


Figure 3: Reduction in COD of Dairy Cattle Manure by Aerobic Treatment

Lagoon Interception, Storage and Application

For the dairies in which the cows are kept out on a large feed floor from which much runoff occurs, the lagoon or earthen storage appears to be necessary.

Lagoon Interception of runoff from feed floors can prevent the polluted runoff from reaching the surface streams. However the lagoon or storage has a relatively "bad" name in many locations because of the malodors emanating from them. A large part of this trouble occurs because of the improper design and usage of the lagoon.

Aerobic Lagoons and Irrigation.

The interception of the runoff and manure of the cows from feedlots by a lagoon that is maintained in an aerobic state is acceptable. Surface aerators have been found capable of maintaining conditions such that little or no odor is produced by them. Excess supernatant is removed during dry [illegible] plant growth periods by an irrigation system. Thus the liquid level is kept low enough to provide space for additional waste materials as they may be produced. This system must have a storage of sufficient volume to catch all runoff that occurs from the late fall until early spring.

In regard to the aeration required, it appears that aeration equivalent to 1.5 times the five-day BOD will definitely maintain aerobic conditions. However it does not appear that this much aeration is required during the winter period. Full aeration should be started early in the spring. Dale (15).

Anaerobic Lagoons may have a place in interception of runoff and manure if they are designed and maintained as they should be. However most of the lagoons of this type are too small, overloaded and tend to become facultative. According to Loehr (25), when an anaerobic lagoon is in biochemical balance, odors are at a minimum and rarely are more than those of the surrounding area. In spite of the problems with anaerobic lagoons, they are practical when used prior to further treatment or land disposal or when they can be integrated into a treatment system to avoid unnecessary deterioration of the quality of the environment.

According to Koelliker and Miner (24), supernatant of anaerobic lagoons can be irrigated onto soils with little odor. Once the relatively dilute supernatant is sprayed into the air, the oxygen of the air stops the anaerobic action and the resulting odors.

Oxidation Ditches

Oxidation ditches have shown only a little promise for dairy cow wastes and research on their adaptation to such has been limited. However as the trend toward complete confinement continues they may have more adaptability for treating and stabilizing dairy cow manure. Of course the stabilized residue still remains to be disposed of by spreading or irrigating onto crops and soils. Also a lagoon or storage shall be needed to serve as a holding tank during time that it is impossible to place the material on the soil.

In the two cases known to the writer where oxidation ditches have been tried for dairy cow wastes, foaming gave much trouble. Also the large undigested feed particles tended to settle out, somewhat restricting the flow in the oxidation ditch.

Composting

Composting is a biological process for the degradation of solid wastes containing organic matter. It has been used to reduce municipal wastes to an odorless, stable material that could be used as a soil conditioner. Biological decomposition may be either anaerobic or aerobic in nature. However, the aerobic process for composting yields a higher temperature during the process and produces a more stable end product with no apparent odor.

The mechanics of composting usually consists of stacking the manure at about 50 to 60 percent moisture in windrows or piles. The stacks are turned or stirred periodically to subject the matter to oxygen.

The composting material usually follows a definite pattern and any deviation from this course may be regarded as an indication of some undesirable development. Within first 24 hours after stacking, the internal temperature of the pile rises to 50°C and subsequently continues to rise though less rapidly, until a maximum of 70–75°C is attained. This high temperature may persist for 3–6 days. As the supply of readily available nutrients diminishes, because of the break down of organic matter, bacterial activity slows down with a consequent decline in temperature. When this decline in temperature progresses until a temperature of 50–55°C is again reached, active decomposition is over and material is stabilized. The whole process usually lasts about 10–15 days depending on the original C to N ratio of the material.

Flies may become a problem at the first week of the composting. But flies and larva gradually diminished after one or two times of turning. During first 3–4 days, the composting material may assume a faint odor which followed by a slightly earthy or musty odor and gradually disappeared. If foul odor is developed, it indicates an insufficient supply of air (oxygen). Such objectionable odor will be dissipated by turning.

Hart (19) experimented with the composting of dairy cow excreta in 1960. He found it to be a highly satisfactory treatment for such manures. He reached the conclusion that composted manure was stable and was not attractive to flies. The resulting product has an earthy odor, is friable and is easily handled. Composting occurs best when the C:N ratio is initially 20 to 1. Pure manures are usually too rich with C:N ratios of 8 to 1, and thus do not compost well.

Willson (47) reported on the evaluation of composting manure from the gutter of a stanchion barn when mixed with straw and wood sawdust as bedding. Dry matter was reduced about 60%. The total weight was reduced about 80%, including the effect of lowering the moisture content from 75 to 50% during the process. Volume was reduced 30 to 50% on a loose basis. In the early stages of the process, temperatures reached 150 to 170°F. The temperature gradually dropped back to ambient as the material became stabilized. The final product had a faint musty odor in a moist condition. It is odorless when airdried to about 10% moisture content.

According to Fairbanks (18) composting of dairy cattle manure has been quite successful in California. Generally the manure has been removed from the loafing barn to a composting floor where the composting takes place. The stacks are either stirred or air is forced through them by blowers. In some cases the composted material has been returned to the loafing barn to be reused as bedding. Once additional manure is added, the material is again returned to the composting area for recomposting. After several such exchanges, the material becomes quite stable. Because of the large accumulation, it must be removed to some area for disposal. This is generally done on some crop land.

Ohio Feedlots, Inc. has been quite successful in employing the composting technique in stabilizing beef cattle manure. This has permitted them to operate with a minimum of trouble from odors and possible pollution of soil or water. Pens are started with 6 to 8" of bark for bedding on the soil floor. The accumulation of manure and bedding is removed for composting when the cattle are removed for marketing.

Drying of Dairy Cow Manure

Little specific research has been devoted to artifically drying dairy cow manure. Cursory computations always seem to indicate that it is one of the least economical methods of managing such wastes. Starting with the thin slurry as defecated at about 86-88 percent moisture one can see that much energy would be required to reduce the moisture to some 10 to 12 percent where it would be completely stable. In addition, problems of handling and injecting such a slurry into a drying kiln are difficult.

Drying of cow manure on feed floors or in feedlots has been somewhat successful. However this is possible only in some of the more arid areas of the country where precipitation is minimal. The southwestern part of the country, including the southern part of California produces most of the commercially dried cow manure. The writer observed one such company near Riverside, California where cow manure was stockpiled, dried and bagged for commercial sales. The stockpiled, raw material was already dried to about 30 to 40 percent moisture before processing was started.

The main difficulty with both composting and drying is the lack of a market for the saleable product. Some may be sold certainly. However the low analysis does not give it the demand that a higher analysis fertilizer has. Its use is generally limited to that by flower and compost vegetable gardeners.

Direct Irrigation

Immediate direct irrigation of relatively fresh dairy cow wastes to the soil works quite well in many locations. This is being done in Texas and other southwestern states. The key to this method appears to be the short time storage which prevents the material from going septic, thus odor is kept at a nominal level. Wash water from the milking parlor and milkhouse is used to dilute the mixture to give a product that is sufficiently fluid to irrigate.

By operating the system every day or not more than every three days both the quantity to be irrigated is lowered as well as the accompanying odor.

Incineration

Incineration seems to offer little to the dairyman in the way of managing and disposing of cow manure. At least one would reach this conclusion in searching the literature which appears to be void of research on such a system.

In normal aerobic uncontrolled incineration, much of the gases escape into the air polluting it. Also a residue is left that still must be handled in some manner. The residue is rich in nutrients and may be usable as a fertilizer.

Anaerobic incineration (pyrolysis) by White and Taiganides show that sufficient heat energy is available for the complete incineration of all animal wastes checked.

Quantities of gas produced and their average composition are given in the following Table; all units are in ml of gas per gram of total solids (ml/g TS) of manure:

Waste	*Total Gas*	CO_2	*CO*	H_2	O_2	N_2	*Others*
Swine	309	64	41	75	11	54	41
Beef	381	69	70	113	17	72	54
Dairy	477	86	59	ND	22	ND	ND
Poultry	437	82	91	125	15	65	31
Newspaper	254	52	42	60	26	ND	ND

About 50 to60 percent of the gases produced are combustible. These gases can be reclaimed for heat energy. The total heating value was calculated at 7200 Btu/lb TS for poultry manure, 64,000 for beef cattle, 5500 for swine, and 5000 for dairy cattle manure.

An advantage of pyrolysis or incineration is volume reduction and the production of dry and innocuous residue.

Recycling

Direct recycling of dairy cattle wastes has been accomplished by Anthony with some relative good results. At least it did not appear to be detrimental to the dairy cows. Of course it appears that most of the readily digestable materials have been removed and the recycled fecal matter serves mainly as a "filler" or low quality roughage for the cow.

Other Methods

Many other methods are being investigated by various organizations and researchers for the possible use of dairy cow wastes. They are as follows:

1. Making into building blocks with glass
2. Squeezing into oil
3. Using hydroponically to produce plants
4. Synthesizing into proteinaceous materials and other products
5. Transported by beetles to soil
6. Placing in landfills
7. Feeding fish
8. Growing algae
9. Producing methane and other gases

Each method has some merits but most of them do not offer an economically sound method for treatment, handling and disposal. Of course, as the size of operation increases, some of these methods may become more feasible. However, until that time, the direct or indirect return of the wastes to the soil to support plant growth appears to be the more feasible way to handle dairy cattle wastes.

Odor Control

Most odor control research to date has dealt with swine or poultry wastes. This is probably due to the fact that odors around the swine and poultry production units appear to be more objectionable. Most dairymen handle their manure immediately in either a liquid or semi-solid condition. Also as may be noted by the size of operation, dairies are not generally large in relation to the size of farm on which they exist. As a result, neighbors are not so close to the operation. Thus when all factors are considered, dairy cow manures have not received "top billing" when odor was considered. However, this is not to say that odors do not exist around dairy units or when dairy cow wastes are spread. Some three years ago (1968) the writer observed the spreading of some 68,000 gallons of semi-liquid dairy cattle manure within about one-half mile of West Lafayette, Indiana. This manure had been stored in underground tanks for several weeks and it was putrid. Thus on spreading, many odorous gases were eliberated and everyone in the city was aware of it. It was accentuated by a cold front passage that resulted in the wind blowing from where the manure was spread directly across the town. Needless to say, this problem has been avoided ever since.

Odor control by aeration has been noted and discussed by a number of researchers. Aerated lagoons and ditches have served to control odors of a number of dairy cow waste storage. Surface aerators have worked particularly well according to Dale.

Although there appears to have been little research in regard to their use, certain oxidizing agents have been reported to temporarily control odors while spreading of wastes. Among these are chlorine and ammonium nitrate.

SUMMARY

Dairy-cow herds are proportionately small, averaging about 30 to 40 cows per farm. Although the trend in size is upward, the rate of increase is quite low. It appears that the average size herd in the U.S. may reach some 70 to 80 producing cows by the late 1980s or the year 2000. However, there are certain localities where larger herds do exist such as the Riverside and Ontario, California locations. The average size herds in some locales may reach 125 to 150 producing cows.

In general it appears that dairymen have done a good job of returning their wastes to the soil. This possibly has been influenced by the sanitarians and other health officers that visit such operations to check compliance with the rules and regulations for the production of Grade A milk. Handling the manure as a semi-solid is still the preferred way. However, liquid handling is now being readily accepted and adapted to the dairy operation. This is particularly true for the completely enclosed operation where runoff does not add to the volume to be handled.

Typically farm acreages are such that sufficient land and crops are available for absorption and utilization of the wastes produced by the dairy cows thereon without polluting the soil, water, or air. Most dairy farms have approximately 3 to 4 acres of land per cow. Research seems to show that one acre of land, dependent on the soil type, crop, method of application, etc., may absorb and utilize continuously the wastes from 2 to 3 dairy cows.

Generally dairies are widely scattered and a large quatity of wastes does not accumulate in a small area. Thus it appears that this factor will have a rather profound effect on any location of a waste processing plant to utilize such products. For example, a 40-cow herd will produce only 110 to 125 tons of dry matter yearly. Thus any operation setting up to process dairy cattle manure generally will be faced with a large collection and hauling problem. Also as the wastes have about 85% moisture in it as it comes from the cow, the problem is accentuated.

Runoff from outside feeding floors appears to the most difficult problem confronting dairymen at the present. Without proper precautions, heavy rains may wash nutrients and organic solids into nearby streams. Also the runoff often adds a disproportionate quantity of water to the liquid tank, thus causing undue labor and other costs in spreading of the soil. Lagoons appear to be the more satisfactory method for intercepting such runoff. However the excess supernatant must be irrigated onto land somewhere and not permitted to overflow into water resources.

Aeration can be used to control odors emanating from lagoons. It may also eventually be adapted to some form of oxidation ditch under the floors of completely covered units.

CATTLE FEEDLOT POLLUTION*

FRANK G. VIETS, JR.

Soil Scientist
Fort Collins, Colorado

INTRODUCTION

Imagine a situation where 1 million people are crowded together in an area no larger than 320 acres.

This supposition is not posed to draw attention to the possible consequences of the population explosion, but to raise concern for the pollution from a modern cattle-feeding operation in any of several Midwestern or Western States. For in terms of biological oxygen demand (BOD) of waste, the number of cattle on many feedlots could be equated to a human population of the above magnitude.

Admittedly, equating cattle and humans on the basis of BOD of the wastes put through a sewage treatment plant is somewhat unrealistic. But the comparison does dramatize that never in history have we brought together such a mass of breathing, kicking, excreting life on land surface. No wonder we fear problems of pollution of air, surface and ground water, and even the soil itself. We have never had such an experience. I should point out that public health authorities are not yet concerned about such concentrations of animals posing an unusual threat to the health of workers and neighbors. However, a homesite near a feedlot may not be regarded as a pleasant or aesthetic environment.

In these days of suspecting pollutants everywhere and blaming the other fellow for them, agriculture has received its full share of accusations. Scarcely a day goes by that the newspapers do not carry a story about a fish kill, a law suit, a cease and desist order, or a zoning problem connected with animal feeding. Agriculture receives more black marks on the pollution scoreboard for wastes problems from animal production than from any of its other activities, even though soil sediment from farmland and suburban development is still land's greatest contributor to pollution (*13*).

Trends in Size and Location

Many cattle feeding operations are no longer a farm enterprise in which the farmer fattens the calves he grows or the carload or two that he buys to consume excess feed produced on the farm. It has become an industry with huge capital requirements. Purchase of most of the feed, hormones, cookers, veterinarians, computers for ration control, futures hedging, and manure handling equipment of a scale befitting the construction industry. The trend is to vertically integrate feeding, slaughtering, breaking, and purveying operations. A look at the balance sheets of the publicly-owned corporations shows good to excellent return on investment. The economies of scale are not likely to be

---

*Originally published in *Agricultural Science Review*, Vol. 9 No. 1 First Quarter 1971.

Preceding page blank

abandoned unless compelled by legislation or regulation in the name of pollution control.

Significant trends are also showing up in beef consumption and manner and site of production. Per capita beef consumption in the United States has increased about 3.5 percent a year for the last 20 years. About 16 million cattle are now fed annually. The number is increasing about half a million a year. In 1954, about 40 percent of our beef came from feedlots; in 1968, more than 67 percent. Density of animals in the feedlot has been steadily increasing to as high as 870 per acre, or 50 square feet per animal, in dry California and Arizona. Such high densities appear incredible, but they are used. Studies (8) in the Imperial Valley of California indicate that space less than 40 square feet per fattening heifer reduces gains and feed efficiency, and that 50 square feet of space was probably less desirable than 60. Corn Belt experiment station recommendations call for a minimum of 400 square feet per head on unsurfaced lots to 30 square feet per head in surfaced lots with open housing (7).

Because of the abundance and proximity of feed grain supplies, cattle feeding is concentrated in four areas. One is in southern California and Arizona, where about 3 million head are fed annually. This area, however, has showed little growth in the last 7 years. In fact, feedlot numbers declined 15 percent in California and 6 percent in Arizona for the year ending September 1, 1970. The number of lots with more than 16,000 capacity rose from 23 in 1962 to 36 in 1968.

The area that has grown most spectacularly is centered in the panhandles of Texas and Oklahoma where more than 5 million cattle are fed annually. The number of lots with more than 16,000 head was 33 in 1968, up from none in 1962. For Texas, the number on feed on September 1, 1970 was 7 percent higher than a year earlier.

The third area is in the central Corn Belt, where the number on feed rose from about 5.6 million in 1962 to about 8 million in 1969. In 1968, there were no operations with over 16,000 head.

The fourth area lies from eastern Colorado through Nebraska to the North Dakota line. Fed cattle numbers are now about 6 million, having doubled since 1962. There were 10 lots with more than 16,000 head in 1969. The number on feed September 1 increased 27 percent in Colorado and 14 percent in Nebraska over the number a year earlier.

Recognizing Pollutants

There are at least two approaches to the recognition of an environmental problem. One is the practical approach of the layman who notes a condition that annoys him and decides he can no longer tolerate it. However, environmental changes often occur slowly and may become significant before complaints arise. Then, too, there is the tendency to think of the past as Utopia and to forget the pollution that formerly was natural and accepted. With respect to cattle feedlots, the commonest nuisances are offensive odors, flies and dust in the air, polluted streams, an occasionally polluted well in or near a feedlot, and mountains of manure. (See photo, p. 3.)

The second approach is to learn something about the effects of a pollutant—whether it be a chemical, a particle, or heat—and determine by more scientific methods what it means to the environment. Many ecologists believe that we should know all of the consequences of a chemical in the environment before it is used.

In a feedlot, however, we are dealing with perhaps thousands of chemical compounds in feces that come from feeds, animal metabolism, and microbial byproducts produced either in the animal or by putrefaction on the feedlot surface. Little is known about these compounds or their environmental significance. Among them are large quantities of urea, which quickly hydrolyzes to ammonia, and volatile amines, skatole, indole, sulfur compounds, and organic acids that have bad odors.

The recent concern about the nitrosoamines and cancer in people (2, 5) illustrates the depth of our ignorance about specific toxins or their precursors in animal wastes. Carcinogenic nitrosoamines can form through chemical reactions of nitrite with secondary amines. Acidity favors the reaction. Nitrite in substantial amounts can accumulate in manures and feedlot soils either as a lag phase in nitrification resulting from low temperatures or high alkalinity, or as a step in microbial denitrification. Some evidence exists that secondary and tertiary amines (triethyl amine) occur in air where hogs are confined; so we may have the reactants in feedlots, if we have the reaction conditions. Cattle feedyards, however, are usually highly alkaline because of ammonia and so we may be spared. Recent studies on aqueous systems of di- and tri-methyl amine and sodium nitrite in imitation of the reactions of nitrite used to preserve smoked chub salmon did not reveal the formation of detectable amounts of dimethylnitrosoamine, even at a temperature of 80°C., and pH as low as 5.8 (*6*). Public health authorities see no connection between cattle feedlots and the incidence of human cancer.

Gross Pollutants of a Feedyard

Table 1 gives some of the grosser measurements of significance in pollution. Values shown are on a daily basis per 1,000-pound animal, total for a 140-day feeding period per animal, and for an acre of feedyard stocked for a whole year with 360 animals. Composition data are from Taiganides and Hazen (*12*). The feeding period, average animal weight, and stocking rate are from a successful Colorado operation.

TABLE 1.
SOME CONSTITUENTS OF WASTE OF A 1,000-POUND BOVINE ON A DAILY AND FEEDING PERIOD BASIS, AND ON AN ANNUAL ACRE BASIS WITH 360 HEAD PER ACRE

	Per day	*140 days*	*360 head/ac-yr*
	Lbs	*Lbs*	*Tons*
Wet manure & urine	64	8,960	4,200
Dry mineral matter	2.1	294	144
Dry organic matter	8.2	1,148	540
Water	53.7	7,518	30.7 in.
Total nitrogen	0.38	55	24.9
Total phosphorus	0.048	6.7	3.2
Total potassium	0.26	36.4	16.8

These values can vary widely, but they still illustrate the enormity of the waste problem.

Why are the constituents in table 1 significant in pollution? If the organic matter gets into water, about 20 to 30 percent of the pollutant is readily decomposed by micro-organisms that use oxygen, the BOD of waste. The combination of the absence of oxygen in water and toxic concentrations of ammonia will kill fish. The dry mineral matter is largely soluble salts and gives an indication of the salt load. Because a corral is a salty place, the runoff can be high in salts. Very heavy applications of manure on land can accentuate a salt or salinity problem. In some areas, feeders add 1 percent salt to the ration to control urinary calculi—a practice that produces an enormous amount of salt, and much of it is sodium chloride. Sodium decreases the water intake rates of fine-textured soils receiving heavy applications of such manure. Nitrogen and phosphorus are significant because they may contribute to the eutrophication or overenrichment of water, which in turn leads to noxious algal blooms, that cause bad taste in water, damage it for water sports, and use up the oxygen when the algae die and decompose. Nitrogen can also be converted to nitrate by nitrifying organisms in either soil or water and be a specific pollutant of water supply.

Although the amount of waste per day per animal seems insignificant, a look at the total excreta for a whole acre of animals for a full year emphasizes the magnitude of the disposal problem. The 684 tons of dry organic and mineral matter for an acre of 360 animals for a year represents the "ashes" from about 2,800 tons of feed they consumed. These "ashes" are enormously enriched in mineral matter of all kinds, including microelements, potassium, phosphorus, and nitrogen. If we assume that 75 percent of the mineral matter is soluble in water and that it runs off or percolates in a foot of water, we have a salt concentration of 8,000 p.p.m. This water must be diluted from its electrical conductivity of 12 mmhos/cm. (a measure of salinity) with 47 acre-feet of pure water to get a conductivity of 0.25 mmhos, which is the upper limit of salt for a class I irrigation water. These calculations do not take into account the sodium hazard of the water, which would be low for animals fed a normal ration but high for those fed a high salt ration.

If all of the waste from an acre of animals were put through a secondary sewage treatment plant like that used for municipal sewage, the population equivalent would be 2,880 to 3,600 people. A 100,000-head feedlot would be equal to a million people. Even though such treatment would remove sufficient BOD so that the water could be released into a stream, as much as 80 percent of the phosphorus and over 50 percent of the nitrogen would remain to pollute the stream. Furthermore, large amounts of water would be needed to run such a plant. Therefore, such a disposal system is never seriously proposed.

However, equally impractical systems of waste disposal are being proposed, such as complete lagooning of all waste, complete incineration, and allotment of land for the specific purpose of just decomposing waste. In my opinion, none of these schemes will turn out to be feasible or economic. *The solution to the problem is to return the solid waste to the land in sufficient amounts for near maximum production of crops without waste of the animal feces resource.*

Solid Waste Disposal

According to the statistics of one large Colorado feeder, about an acre of irrigated land produces enough corn silage, alfalfa, and 100-bushel corn per acre to fatten 1.62 animals. According to table 1, 1.62 animals would produce about 2,340 pounds of dry waste. If an acre of cropland can safely use 11.7 tons of dry manure per year for the production of feed grains and corn silage, then only about one-tenth as much land is needed for productive waste disposal as for growing the feed. We need more information on the maximum amount of manure that can be used in crop production without pollution, waste of this resource, and converting land into a garbage dump.

People argue that since commercial fertilizers have become relatively cheap, a ton of average wet manure contains only about $1 worth of nutrients and therefore is not worth hauling and spreading. Since it does have to be scraped up and hauled somewhere, the argument that it isn't worth putting on the land does not appear to have validity. The old established feeding areas, such as the Corn Belt and northeastern Colorado, have little trouble in disposing of manure, but new areas such as southern California and the panhandle of Texas do. Cattlemen in the latter areas seem to prefer to make mountains of it. Historical, if not cultural, attitudes have something to do with the disposal of manure. Perhaps the old established areas have learned that there is some value to manure in maintaining soil productivity besides just the N, P, and K it contains.

Now that we have disposed of the manure, we can look at some of the water and air pollutional aspects of the feedyard that are less easily handled than the solid waste.

The Nitrogen Balance of a Cattle Feedyard

About 25 tons of nitrogen an acre is excreted on a moderate density feedyard if it is used the year around (table 1). This nitrogen must be disposed of by hauling, runoff, deep percolation of nitrate and soluble organic nitrogen compounds, volatilization of ammonia and possibly other bases, or be denitrified to harmless nitrogen gas on the site. The magnitude of the pathways of loss depends on management, slope, nature of the feedlot surface and, of course, precipitation and climate. However, we have a very poor understanding of any one set of circumstances without making the situation worse by trying to understand all of the combinations.

About half of the nitrogen of feces is in urine as urea, which quickly hydrolyzes to ammonia. The feces contain no nitrate. The nitrate is produced on or near the feedlot surface by nitrifying bacteria whose activity depends on temperature, aeration, and the density of stocking. On a high density yard, nitrification is retarded by the high pH and toxicity of ammonia. For example, Stewart (*10*) added cattle urine to soil columns every 4 days for 8 weeks to simulate a dry feedyard with 150 square feet per animal. The soil pH rose to 9.9 from about 7, no nitrate was formed, and ammonia accumulated to about 670 p.p.m. All of the water in the urine evaporated and no leaching occurred. About 90 percent of the urinary nitrogen evaporated as ammonia. When urine addition was stopped and water additions substituted for 2 weeks, pH and ammonia decreased and nitrate accumulated.

Stewart's work illustrates some of the fluctuations in pH, ammonia accumulation and loss, nitrification, and nitrate movement that may occur under feedlot conditions to the urine, depending on management and location. Such management variables include the density of stocking, precipitation-evaporation relations (we call this part of climate), and continuous vs. intermittent feedlot use. We do not have sufficient measurements now to know what all of these variables mean in nitrogen pollution in the real feedlot world.

Gilbertson et al. (*3*) conducted an experiment at Mead in eastern Nebraska on unpaved feedlots with two cattle densities and three slopes of 3, 6, and 9 percent. For two consecutive feeding periods of 112 and 203 days, manure removed by hauling accounted for only 51 percent of the nitrogen excreted on the lots. For the 203-day feeding period only, with more complete data, nitrogen removal could be accounted for as follows: cleaning and hauling—59.1 percent, winter (snow) runoff—10.1 percent, spring and summer (rain) runoff—1.3 percent. Total removal accounted for only 70 percent of the nitrogen excreted. Some nitrogen entered the soil as nitrate, ammonia, and organic compounds, but the percentage is not known. It would be small. The rest was either denitrified or escaped as ammonia. The data on nitrogen removed in manure are biased because of dirt that is invariably removed with manure in cleaning unpaved feedlots. Although these figures are not conclusive, they are some of the best available on the nitrogen budget of cattle feces under unpaved feedlot conditions characteristic of most of the industry.

A complete accounting for all nitrogen entering a feedyard is now impossible, and perhaps the complete picture will never be known under actual operating conditions. Methods are not available now to measure the flux of ammonia and volatile bases from an open feedyard, but perhaps data could be obtained for cattle fed under total confinement. Under unpaved feedlot conditions, the rates of downward movement of nitrate and other nitrogen compounds are difficult to measure because of the apparent slow rates and the extreme heterogeneity of the unpaved feedyard, the conditions being different at the feed bunks, the watering troughs, and the resting places in the yard.

New equipment installed in the past year in feedyards by the Agricultural Research Service staff in Nebraska and Colorado, and by others elsewhere, will permit better measurements of all components of the feedyard water budget including water intake and spillage by the cattle. Better information should become available on the nitrogen budget and on runoff and deep percolation. Vacuum lysimeters (*1*) with a porous plate in the bottom so that suction can be applied automatically, equaling that on the soil water at equivalent depth, have been installed. Another innovation has been the installation of caissons—hollow steel cylinders 42 inches in diameter, extending from the lot surface to the water table, and large enough to permit personnel access.

Caissons facilitate measurement of redox potential, collection of gases and soil solution for analysis, measurements of water suction to determine flux, and the injection of isotopes, including nitrate tagged with N^{15}. These measurements are made and samples are taken through ports at various depths in the caisson wall.

Runoff

Before the enactment of Federal and State laws and regulations prohibiting feedlot drainage directly into surface water, the custom was to build feedyards on slopes of creeks and rivers if they were available. Those days are gone. Many feedlots have had to either move or call on the services of engineers to design interception and disposal systems. Much of the data collection effort of recent years has gone into measuring the amount of runoff, its composition, and when the runoff would occur. Obviously, the problem is quite different for a feedlot located in the Salt River or Imperial Valleys than it is for one in eastern Nebraska or central Iowa. In eastern Nebraska, runoff occurs with rains exceeding 0.4 inch on 3- to 9-percent slopes. The runoff amounts to 0.531 times the precipitation minus 0.135 (*3*). The site conditions of roughness, wetness, and amount of manure cover at the time of rain are some of the factors affecting runoff-precipiation relations.

Runoff is potent with pollutants, as shown in the Nebraska data in Table 2. Winter and low-volume runoff is more concentrated than summer high-volume runoff as expected.

TABLE 2.

RANGES OF RUNOFF CONCENTRATIONS FROM UNPAVED FEEDLOTS AT MEAD, NEBR. (3)

	Range of concentration	
Analysis	*Winter runoff*	*Rainstorm runoff*[1]
pH	6.7-7.6	6.6-9.4
Conductivity (millihos/cm)	3.0-11.5	1.0-3.4
Total solids (percent)	3.0-19.8	0.24-1.74
Volatile solids (percent)	1.4-10.7	0.12-0.73
Ash (percent)	1.5-9.2	0.12-1.05
COD (mg/l)	14,129-77,804	1300-8247
P (p.p.m.)	6.8-753.2	13.9-46.6
NH_3-N (p.p.m.)	670-2028	26-82
NO_3-N (p.p.m.)	0-80	0-17
Total N (p.p.m.)	1429-5765	65-555

[1] Concentrations for rainstorm-runoff are for the period April through June, 1969.

The disposal of runoff is outside the scope of this article, but some of the devices used include interception ditches, and aerated or nonaerated lagoons. In Nebraska, Agricultural Research Service engineers and microbiologists are modifying the feedlot surface with level terraces so that runoff is stored right on the feedlot until it can be pumped onto cropland, evaporate, or infiltrate right on the site. Disposal of runoff is one of the costs in the humid regions that feeders in semiarid and desert areas find much less costly. If runoff cannot be disposed of economically in humid areas, cattle feeding will be forced westward to drier climates. A long-range balance between availability of feed grains and ease of runoff disposal will likely be established.

Air Pollution

Air pollution from feedlots consists of odors, dust and ammonia. Odor control, except for occasional cleaning of lots, is an unsolved problem. People who get either direct or indirect economic benefits from cattle feeding seem to get used to feedlots better than other people. Most feedlot owners control dust well by sprinkling their feedlots with permanently installed sprinkler systems. They prefer a wet feedlot to a dusty one that may cause pneumonia in their cattle. Dust control by high urinary output is given as one of the benefits of high animal densities used in arid regions.

Anyone who has gone into a closed chicken house knows about the odor of ammonia. Its odor in a feedlot is scarcely detectable. The amounts in air around feedlots are probably in the range of 20 to 100 parts per billion by weight. No health hazard is involved. However, studies in Colorado (*4*) show that lake surfaces in the vicinity of large feedyards can absorb large amounts of ammonia. One lake about a quarter of a mile from a large feedlot absorbed about 65 pounds of nitrogen per acre per year. Another lake about 1 mile from the feedlot absorbed only half this much, but it was enough to add about 0.6 p.p.m. of soluble N to the volume of the lake each year. This much N is regarded as sufficient for eutrophication if other factors are favorable. Obviously, control of runoff from feedlots is not going to prevent significant N input into adjacent lakes. However, in many Western States, lakes were built for the storage of irrigation water, and so irrigators and fishermen get a better quality of water. Swimmers, boaters, and city water supplies may suffer.

No aspect of pollution from feedlots needs more concentrated research attention than the chemistry of and olfactory response to the volatiles emanating from feedyards. Better management practices for control of odor can only be highly empirical until better understandings of all factors are obtained. Some people suggest that there are rings of odor around a feedlot, the quality of the smell depending on the distance. The current solutions to the problem are cleaning of yards, dust control, and zoning. The latter means that either the people or the feeder must move away. In established areas where housing has moved to the suburban-feedlot interface, it is usually the feeder that moves. Rise in land values has permitted him to do this, unless he had too much invested in feed-mixing facilities. Long-range zoning appears to be one, and perhaps the safest, answer. Perhaps the odor problem cannot be solved.

Deep Percolation

Not much is known about the potential pollution of underground water by feedlots. Nitrate in ground-waters in Missouri has been attributed more to corrals than to fertilizer use on farms (*9*). In Colorado, some of the wells in or near feedlots have had to be abandoned because of unsuitability of the water, even for livestock use. Our core drilling studies in northeastern Colorado have shown that nitrate under cattle feedyards ranged from none to over 5,000 pounds of nitrogen per acre in 20 feet of profile; the average for 47 cores was 1,436 pounds (*11*). For other kinds of land use the average values were: virgin grassland—90 pounds, unfertilized wheat-fallow land—261 pounds, and irrigated land not in alfalfa—506 pounds. Under feedlots, nitrate concentration usually declines markedly with depth. The absence of nitrate in some profiles and the decline with depth in others indicate that denitrification is active under some feedlots. Samples of the water from the top of the water table under different kinds of land use showed no difference in nitrate content because of kind of land use. Samples averaged about 10 p.p.m. of nitrate nitrogen. Thus, we cannot say that feedlots are polluting the water table with nitrate. However, the water under feedlots had an offensive odor and was enriched in ammonium and soluble organic and phosphorus compounds. Therefore, we know that pollution is occurring, but we do not know how fast pollutants move to the water table nor how far they move in aquifers.

Current research of the staff of the Soil and Water Conservation Research Division of the Agricultural Research Service in Nebraska and Colorado in cooperation with the State agricultural experiment stations* indicates that unpaved feedlots pose no general threat to the quality of underground water. Although the contaminants that are moving may be concentrated, the rates of movement are very slow and feedlots occupy a miniscule part of the total area contributing ground water to aquifers. The surfaces of feedlots tend to seal with the tramping of animals and compaction of the surface. These generalizations, however, do not imply that wells in the immediate vicinity of feedyards cannot become polluted with noxious chemicals and odors.

Soil Pollution

Soils used as feedyards apparently do not suffer permanent damage to their ability to produce crops when they are returned to crop production. In the many instances of removal of feedlots to new locations to comply with pollution regulations or new ownership, there have been no complaints about poor crop yields. In spite of the jolt that the soil gets in heavy metals, salts, nitrogen and phosphorus compounds, the effects do not appear to be lasting. Annual weeds soon grow profusely in unstocked feedlots. Although zinc deficiency was a common occurance on old corral areas in California in the 1930's, the problem is not current.

---

*This research is supported financially by the Water Quality Office, E.P.A.

SUMMARY

Our steadily increasing demands for well-finished beef and the apparent profitability of large integrated feeding and slaughtering operations indicate that feedlots will grow larger and not smaller. Cattle feeding is moving from a small farm enterprise toward an agricultural industry. We have never experienced such a concentration of wastes on so small an area. No wonder we are baffled by the problems of runoff, ground water and air quality deterioration. Most large operators are making a valiant effort to comply with water and air pollution regulations. However, the scale of their operations has expanded faster than the knowledge that could help them.

Because stream and lake pollution from runoff is now prohibited, engineers are challenged to design facilities that minimize runoff or dispose of it economically and, hopefully, beneficially. Runoff control is much more difficult in humid climates than in drier ones. Hence, the emphasis must be on economical systems or the feeding industry will be forced to move into drier climates.

Underground water pollution appears to be mostly a local phenomenon. Widespread contamination of aquifers does not appear probable.

Most of the unsolved problems lie in the air pollution area. The significance of increased levels of ammonia in the air to surrounding crops and lakes needs further study. Offensive odors and their control still await thorough application of microbiological and chemical research.

Manure can be disposed of and used as a resource if only a small portion of the land needed to produce the feed is available for manure disposal. Zoning appears to be one of the best solutions to the feedlot problem. Such zoning should include provision for adequate land for manure and runoff disposal.

REFERENCES

1. Duke, H. R., Kruse, E. G., and Hutchinson, G. L. 1970. An Automatic Vacuum Lysimeter for Monitoring Percolation Rates. U.S. Dept. of Agr., Agr. Res. Serv., ARS 41-165.

2. Du Plessis, L. S., Nunn, J. R., and Roach, W. A. 1969. Carcinogen in a Transkeian Food Additive. Nature (London) 222: 1198-1199.

3. Gilbertson, C. B., McCalla, T. M., Ellis, J. R., Cross, O. E., and Woods, W. R. 1970. The Effect of Animal Density and Surface Slope on Characteristics of Runoff, Solid Waste and Nitrate Movement on Unpaved Feed Yards. Nebraska Agrl. Exp. Sta. Bull. 508.

4. Hutchinson, G. L., and Viets, F. G., Jr. 1969. Nitrogen Enrichment of Surface Water by Absorption of Ammonia Volatilized from Cattle Feedlots. Science 166: 514-515.

5. Lijinsky, William, and Eptstein, S. S. 1970. Nitrosoamines as Environmental Carcinogens. Nature, London, 225: 21-23.

6. Malins, Donald C., Roubal, William T., and Robisch, Paul A. 1970. The Possible Nitrosation of Amines in Smoked Chub. J. Agrl. Food Chem. 18: 740-741.

7. Midwest Plan Service. 1968. Beef Housing and Equipment Handbook. MWPS-6, Midwest Plan Serv., Iowa State Univ., Ames, Iowa.

8. Morrison, W. R., Mendel, V. E., and Bond, T. E. 1970. Influence of Space on Performance of Feedlot Cattle. Trans. ASAE 13: 145-147.

9. Smith, G. E. 1968. Pollution Problems: How Much is Agriculture to Blame? Agr. Nitrogen News 18 (2): 32-36.

10. Stewart, B. A. 1970. Volatilization and Nitrification of Nitrogen from Urine Under Simulated Cattle Feedlot Conditions. Environ. Sci. Technol. 4: 579-582.

11. Stewart, B. A., Viets, F. G., Jr., Hutchinson, G. L., and Kemper, W. D. 1967. Nitrate and other Water Pollutants under Fields and Feedlots. Environ. Sci. Technol. 1: 736–739.

12. Taiganides, E. P., and Hazen, T. E. 1966. Properties of Farm Animal Excreta. Trans. ASAE 9: 374–376.

13. USDA-OST 1969. Control of Agriculture-Related Pollution—A Report to the President. U.S. Department of Agriculture—Office of Science and Technology.

POULTRY WASTE MANAGEMENT

RAYMOND C. LOEHR

Professor of Agricultural and Civil Engineering
Cornell University

From much of the discussion one might infer that beef cattle wastes and feedlot runoff constitute the major concern in animal management. Having literally entered my professional activities in this area of the business, animal waste management, with these feedlot problems in Kansas, I can well understand and sympathize with some of the complexities involved in the solution of this problem. But I would like to extend to you some of the interest and concerns of another part of the animal production industry, and to let you recognize that cattle feedlot problems are not the only ones that the animal producers in the United States face.

The challenge that we have been given is to provide you with a concise and positive approach to things that can be done to solve the problem or at least to mitigate the problem. My talk will be to that point, because I feel very strongly that there are approaches that can be utilized to minimize the gross problems that may have made headlines and caused many of the legal entanglements that the agricultural producers and animal producers have found themselves in, especially in the poultry waste management area. There are a number of feasible alternatives and effective solutions to these gross problems.

The problem of poultry waste management is no different than any other part of the animal production industry. It is essentially a problem of concentration. Dr. Dale discussed the size of dairy herds earlier to point out that they are still relatively small. Such is not the case for laying hen operations, i.e., for egg production. In most of the United States, if an egg producer does not have anywhere from 15 to 30 thousand birds under his control, he is not really producing a significant amount of eggs for the market. He may be selling in a local area, but he is not a major egg producer.

The major egg producers have large production complexes. An example of one might hold somewhere around three hundred thousand birds. There are egg production complexes in New York that have birds in confined housing ranging up to close to a half million or a million birds.

This problem is no different than it is with other animal producers. In these houses, the birds are in cages with feed and water supplied to them. In the general commercial house of today, the wastes are defecated through the cages to pits below the cages. The wastes are removed when it is convenient for the operator. Nothing is done with the wastes between the time they are defecated and the time they are removed. Obviously, some rather interesting anaerobic conditions occur in the pits.

Preceding page blank

The problems that result from these pits are two fold. One is when the wastes are removed and spread upon the land since the land is the accepter for these wastes in all cases. When the wastes are spread, the odors generated by the anaerobic conditions are released during mixing, transfer, and the spreading on the land. These odors may not be agreeable to the life in and around these areas.

There have been a number of law suits in New York State. The result of these is that some control must be made of the odors prior or during spreading. In addition, the indiscriminate spreading of these wastes upon the land can cause potential runoff problems.

Many of the largest egg producers in New York have grown up in the area which is the resort area of the state. People come from the cities to breathe the air of the beautiful country of the Catskills. Odors from the anaerobically held wastes can disappoint them. The College of Agriculture and Life Sciences at Cornell University has a large, competent program aimed at finding solutions to these and other agricultural waste management problems.

This problem results because of the way these wastes are being held. Under liquid conditions in the pits anaerobic conditions are taking place. There are a number of alternatives to solve these problems. All alternatives include either aeration or drying combined with land disposal.

We firmly believe that treating these very concentrated wastes, which come directly from the bird, to such a quality that they can be disposed of to the waters of our state or any state, is an improper approach to animal waste management. The alternatives that do exist are to provide some degree of amelioration of odors or some degree of treatment so that they can such be utilized on the land without any other environmental quality problems.

The best alternatives for these types of poultry wastes is to use either a drying system or a liquid system which has enough oxygen to avoid anaerobic conditions. At Cornell, we are fortunate to have a pilot plant which enables us to evaluate four different waste management systems. One system provides an example of an inhouse drying system. This is not the only inhouse drying system nor is it the only type of drying system that exists. It is used here as an example of drying. In this system, the wastes fall onto a platform where there are scrapers and air moving across the surface to increase water removal by evaporation. The air movement is not only from the air moving through the building at three to four cubic foot per minute per bird, but also from an auxiliary blower that brings the air across manure surfaces to more rapidly increase the evaporation. At times waste material can be dried to the level of 25-30 percent of moisture depending upon the humidity. This approach offers certain advantages because we do not get the odors associated with the anaerobic pit. The resultant material is a dry material that offers possibilities for recycling or any way that one can utilize it. The key to this particular system is the method of utilization or final disposal. If a market or use for the product exists, a drying system is a feasible approach.

The other alternative is to go to a liquid system which is aerated to a level that will minimize any anaerobic conditions. Both a diffused aeration system and a surface aeration system are under evaluation at the Cornell Agricultural Waste Management Laboratory. Both can operate satisfactorily. However the oxygen transfer characteristics for the diffused aeration system are less than for a surface aeration type of a system. This means that either one has to manage this system with much lower loadings or you are going to use more horsepower in order to transfer enough oxygen to the system. The odors from a well designed and well run aeration system are no more than would exist in a typical office. The point is, by going to a liquid system with adequate aeration, one can minimize obnoxious odor problems.

The surface aeration system is an oxidation ditch directly below about 250 birds. Oxidation ditches are known to foam. We have been very fortunate with foam in our system. We have the foam under control literally at all times and we have learned how to manage the foam so that we get a minimum, probably no more than about an inch under our current operating techniques.

This aeration system, the oxidation ditch, uses surface aerators. There are many types on the market that can provide enough oxygen into the system to minimize on the odors and to provide some degree of pollution control for any liquid system that you might use.

We don't know whether the following is typical, but in our oxidation ditch that we have studied for about 15 to 18 months, there has been no overflow because of a high evaporation rate. Thus, this oxidation ditch is a long term aerated storage unit providing the flexibility of pumping out to the land under whatever appropriate conditions exist for crop management. The aim of this system is to put the wastes back on the land in a suitable condition and provide a flexible operation for the producer.

There are many other aeration systems that can be used such as ones with the overflow going to a solid separation system with the liquid perhaps being sent to receiving water and the solids to the land. With others one can go directly to the land.

I will echo some of the points made earlier today about the quality of material from any type of an aerated system treating concentrated animal wastes. It is extremely unlikely that the quality of these aeration systems can be made such that the resultant effluent can go directly into any body of water. The effluent will contain residual salts, color, nutrients, and exert some oxygen demand. The resultant material is not odorous and can be stored for a short time prior to land disposal. Aeration should be used if prolonged storage of the effluent is needed or desired.

We feel very strongly that the place to put agricultural wastes is back on the land. There are alternative techniques that can be used prior to land disposal. A drying system or a liquid system has its own advantages and disadvantages and its own cost relationships. The decision to use either alternative is up to the particular operator.

With either the dry or liquid systems I have discussed, there has been no significant difference on the birds or on the egg production. Thus, neither of these alternatives causes additional problems affecting the production operation. Therefore these alternatives are feasible, effective solutions that do not appear to harm egg production.

The problem of nutrient control is another factor which requires concern when investigating alternative approaches for agricultural waste management. There are interesting applications that can be combined with dry system as well as the liquid systems for nitrogen control. Initial material balances with the oxidation ditch indicated at least 30 percent nitrogen removal. The results of our recent experimentation and research indicate that it is feasible to introduce a nitrification/denitrification system in the oxidation ditch to remove nitrogen to whatever level might be safe to put it on the land in what ever crop management system might be feasible. We are working closely with our Agronomy Department to come up with loading rates that relate to the quantity and quality that can go on a given quantity of land, especially in New York State, without causing environmental quality problems.

I would echo previous comments that ammonia release to the atmosphere, while a technical approach to nitrogen removal, is not the best approach because of the environmental problems that can result when it comes down. If it does come down on crop land, it can be taken into account in nitrogen estimates of how much nitrogen should go on the land for crop production. Unfortunately it doesn't always go down there but can end up in our surface waters. However, if one can nitrify and denitrify, the resultant nitrogen gas and oxides end up in the atmosphere, with the other 80 percent of nitrogen that is in and around us. Few environmental problems will result from this method of nitrogen control.

There are many different poultry operations. The spectrum can be illustrated by moving from a very concentrated system to a very diluted system, such as occurs from duck production on Long Island. These growers produce approximately 50 percent of the ducks that are grown in the country for restaurant use. In the past, the waste from these duck operations have been the cause for detailed pollution control activities enforced by the New York Department of Environmental Conservation.

The characteristics of duck waste water is considerably different than what one obtains in egg or broiler operations. This waste water is almost like strong domestic sewage and requires other approaches for treatment and handling of this particular waste. Control is necessary of the oxygen demanding material, the solids, the bacteria, and the nutrients.

Those of you from other parts of the country who feel the desire of pollution control agencies can understand the type of control the duck producers must provide. First, the ducks had to be removed from off of all open and public waters. Then, a solids control system and an aerated treatment system was required. They also have to chlorinate their effluent to effect bacterial control and reduce the coliform bacteria to low concentrations. They are also under orders from the Department of Environmental Conservation of the State of New York to remove phosphorous from their effluents. In pollution control activities, the duck producers are leaders in what may well come to other parts of the country.

My point of emphasis in this paper is that there are reasonable and feasible solutions that can be utilized now for control of the wastes from agricultural operations. These should be incorporated into practice as soon as possible.

Let me conclude by indicating the need to determine overall rather than piecemeal solutions. It is very common for many people in the whole industry to consider the problems associated with the treatment and disposal of animal waste. This is but part of the overall problem. The overall problem really begins with the feeding of animals, their housing, the type and quantity of material of feed and waste, and the handling, treatment, and disposal of the wastes. The whole production system should be evaluated for waste management alternatives as well as looking at treatment and disposal. We must make sure that our research and all technical work indicates how the whole production system will be affected by any waste management alternatives and improvements. We have the dual constraints of adequate environmental quality and adequate profit for the producer. Frequently, these two are diametrically opposed. They need not be. We like to remember the one, environmental quality. At the same time you must remember the other one, adequate profit. If we do not provide adequate profit for the producer, all agricultural products will increase in price affecting all Americans.

The overall constraints are that what we must provide a total system for production and waste management that is economical. Not necessarily waste management, but the overall system must be economical. There are numerous possibilities for reuse that have been alluded to and will be taken care of. But, as I close, I draw your attention to the fact that it is the overall concept to which we must ultimately address our attentions. This is one of the larger challenges that face all of us in agricultural waste management. Thank you.

SWINE WASTE MANAGEMENT

ARTHUR J. MUEHLING

Associate Professor, Agricultural Engineering Department
University of Illinois at Urbana-Champaign

INTRODUCTION

When hogs were fed in small groups on pasture, the handling and disposing of their wastes was minimized and very little pollution occurred. With the present trend toward raising larger groups of hogs in a more concentrated area, the disposal of the wastes is a greater problem. Most swine producers are very much concerned about preserving the environment—for their own families and their neighbors. They do need some help in selecting proper handling and disposal systems. They also need help in developing new methods to further aid them in controlling pollution. Current systems for handling, treating, and disposing of swine wastes will be discussed in this paper including proper management methods and the limitations of the different systems.

Trends in Swine Production Systems

Hog production systems have changed markedly during the past 20 years. Before 1950, hogs were raised in rather small groups, utilizing portable houses on clean pastures. The Illinois McLean County system of raising hogs emerged as the proven production system in which hogs were farrowed in individual houses on pasture and fed out on pasture. The pasture lots were rotated to continually provide clean ground for the pigs. Very few pollution problems existed when using these practices.

Later many producers began to increase their hog numbers to better utilize their equipment capacity and managerial ability. The number of farms selling hogs declined but the number of hogs marketed increased. In the 10 Corn Belt states where over 80% of the hogs were sold in 1964, the number of farms selling hogs declined 27% from 1959 to 1964, but the number of hogs sold increased 6%. The total number of farms selling 200 or more hogs increased 24% in this same period.

Some of the larger producers built central farrowing houses or during the cold winter months moved their individual houses up to the farmstead along a concrete slab where they had access to pressure water and electric power. The use of electric power along with centralization of the individual farrowing units helped provide better environmental conditions and helped reduce the work load during inclement weather.

During the past 10 years, an appreciable number of hogs have been raised in confinement. In 1966 in Illinois, about 50% of the hog farms used central farrowing houses and about 35% finished in confinement. The number using central farrowing and confinement finishing has greatly increased during the past 5 years in the Corn Belt as well as in other parts of the United States.

Before the adoption of slotted floors, manure was removed from confinement units by hand-scraping or scraping with a tractor, by washing with high-pressure water, by using a mechanical scraper, or by various combinations of these methods. The amount of labor and type of labor needed to scrape or wash the feeding floors and dispose of the wastes discouraged many producers from raising hogs in confinement. The adoption of slotted floors has done much to influence the trend toward confinement by reducing or almost eliminating hand-cleaning and making it possible to pump and handle the wastes with mechanical equipment, eliminating many of the more undesirable tasks previously associated with confinement rearing of swine.

In recent years the favorable cost and availability of nitrogen fertilizer has greatly expanded the corn production areas in the United States and brought new producers into hog production. New producers are always looking for the latest technologies, and confinement housing therefore spread faster in the new production areas than within some of the established areas where older production systems were deeply entrenched.

Pasture systems are still being used successfully. However, many pasture systems have also changed during the past 20 years. Instead of a few hogs scattered over a fertile pasture, today many pasture units have increased considerably in volume and become quite concentrated. Some of these pastures are void of vegetation and bare like a concentrated feedlot. Pollution problems during rainy weather can be quite severe from some of these units.

When public concern over pollution first became an issue, confined livestock units were among the first to be isolated as possible polluters. Today, however, a properly planned confinement livestock unit under roof with adequate manure storage and proper handling facilities can operate without causing pollution. The confinement operator has all the wastes confined and isolated from the runoff. To avoid pollution, he only needs to adapt a suitable method of disposal. The pasture producer—particularly on hilly land—has the problem of collecting the runoff so it can't pollute. If he does find a method for collecting the runoff, his problem will be enlarged because the wastes will contain large amounts of drainage water.

Properties of Swine Wastes

An understanding of the properties of swine wastes is necessary to develop an adequate system of waste management. Normally, when procedures used in the treatment of municipal sewage have been applied without modification to the treatment of swine wastes, they have seldom performed as expected.

The properties of swine wastes may be affected by the physiology (size, sex, breed, and activity) of the animal, the feed ration (digestibility and the protein and fiber content), and the environment (temperature and humidity). The quality of the feed influences the amount the hogs will eat (which will be reflected in the quantity of manure produced) and the chemical composition of the wastes. Hog wastes will contain all the ingredients of the feed, some in their original form, others in chemical modified forms.

The addition of antibiotics and other drugs in the ration for disease control may affect the biological properties of hog wastes. When large doses of antibiotics are administered to the hogs, a sufficient portion may pass through the digestive tract and severely limit biological treatment of manure unless it is diluted sufficiently so that toxic concentrations of these antibiotics do not develop.

Daily production of wastes from hogs varies considerably, depending on type and size of hog, method of feeding, and what is included in the wastes, especially the amount of waste water. Average daily manure production (feces and urine) per 100 pounds of live weight are approximately: ⅛ cubic foot, 1.0 gallon, or 8.0 pounds. The average figures in Table 1 can be used as a guide to calculate the amount of manure produced by hogs of different weights. The total amount of liquid to be handled can be affected more by the amount of wastage from the many pressure waterers in a confinement system than by any other single factor. A good estimate of the daily amount of liquid waste to be handled from a confinement operation (liquids and solids plus wastage from waterers) is 10% of the live animal weight on feed at that

TABLE 1

APPROXIMATE DAILY MANURE PRODUCTION

(Median Values for Undiluted Manure Without Bedding)

Size of hog		*Waste production*			
		Liquid and solids		*Wet solids only*	
Age (weeks)	*Weight (pounds)*	*Cu. ft.*	*Gal.*	*Cu. ft.*	*Lb.*
Pigs					
6–9	40	.06	.5	.04	2.4
9–13	100	.13	1.0	.1	5.9
13–18	150	.21	1.7	.15	8.8
18–23	210	.30	2.2	.2	12.0
Sows, Boars					
20–52	300	.43	3	.3	17.5
52 +	500	.71	5	.5	30.0
Sow + litter	——	.55	4	.5	30.0

(Adapted from Midwest Plan Service, 1969)

time. This means that an estimate of the daily waste production from 600 head of finishing pigs averaging 150 pounds would be 9000 pounds (150 × 600 × .10) or 4½ tons per day, which equals about 1,080 gallons. In a typical 100-sow herd where about 30 sows are farrowed six times per year, there would be approximately 5 tons or 1,250 gallons of liquid manure produced daily which must be handled and disposed of in a satisfactory manner.

Pollutional characteristics of swine wastes will also vary considerably. Table 2 shows average characteristics of swine wastes per 1,000 pounds of live weight.

TABLE 2

CHARACTERISTICS OF SWINE WASTES PER 1,000 POUNDS LIVE WEIGHT

(National Pork Producers Council, 1970)

Solids content	15–25 percent
Moisture content	78–85 percent
Biochemical oxygen demand (5-day)	3 pounds per day
Chemical oxygen demand	7 pounds per day
Nitrogen	0.4–0.7 pound per day
Phosphorus as P_2O_5	0.3 pound per day
Potassium as K_2O	0.3–0.6 pound per day

The major potential water pollutants from swine manures are oxygen-demanding matter, plant nutrients, and infectious agents. Color and odor are contributing substances. The problem when considering treating these wastes adequately to discharge the treated effluent into a watercourse is the unusually high concentrations of oxygen-demanding matter in these wastes to be treated.

Table 3 shows the average BOD concentrations for different types of wastes. Undiluted swine wastes have a BOD concentration over 100 times greater than the BOD of municipal sewage. These very high concentrations usually

TABLE 3
TYPICAL BOD CONCENTRATION FOR WASTES
(Day et. al., 1971)

Type of Waste	*Biochemical Oxygen Demand (BOD), mg./liter*
Untreated liquid	
Swine waste	35,000
Runoff from concentrated feedlot	1,000
Manure lagoon supernatant	700
Manure oxidation ditch supernatant	150
Untreated municipal sewage	250
Treated municipal sewage (after secondary treatment)	20

make it uneconomical and unrealistic to directly apply municipal sewage treatment practices to the treatment of swine wastes. Recent effluent standards almost eliminate the possibility of adequately treating swine wastes so the effluent can be returned to a natural watercourse. For example, the present standards in Illinois require the BOD of treated effluent to be reduced to 4 mg./1. before it is allowed to enter most secondary streams and to 30 mg./1. when released directly into major streams such as the Mississippi River. It appears that most of the swine wastes sometime must be returned to the soil to avoid pollution.

Miner and Willrich (1970) point out that since livestock wastes are not usually collected, transported, treated, and discharged into a receiving stream, as municipal sewage almost always is, a quantified prediction of water-quality deterioration caused by swine wastes cannot be made as it can for municipal sewage. Any calculation of a BOD population equivalent for swine wastes assumes that the total wastes from these animals are discharged into a stream and released at a uniform rate either with or without treatment. This is not valid for swine wastes or any other livestock wastes except in a most unusual situation.

Fertilizer values of livestock manure have been researched quite extensively, but the reported values vary considerably. The plant nutrients in hog manure come from the feeds consumed by the hogs. There is less urine than solids, but the urine contains about 50% of the fertility value of the manure. An average fertilizer value of hog manure is 0.7% nitrogen (N), 0.4% phosphoric acid (P_2O_5) and 0.4% potash (K_2O). This means that a ton of hog manure (about 265 gallons) would contain 14 pounds of N, 8 pounds of P_2O_5, and 8 pounds of K_2O.

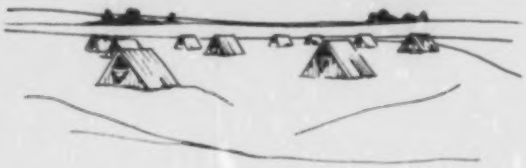
Normally, swine wastes must be spread on the land throughout the entire year. When substituting swine wastes for fertilizer, the producer is concerned as to how many nutrients remain for the plants to utilize after a winter of leaching in the soil and being washed away. Many farmers will incorporate the manure into the ground, reducing leaching and runoff as well as reducing odors. Today in light of the plentiful supply, low cost, and availability of commercial fertilizers, many producers wonder if it pays to collect and use hog wastes as a fertilizer. A majority of the hog wastes are spread on the land as a means of disposal more than for the fertility value.

Handling Wastes from Swine Production Systems

A manure-handling system can be as simple as scraping floors and hauling the solids to the field or as complex as using slotted floors with a waste treatment facility and returning the by-products to the land. Most larger hog producers use a combination of manure-handling techniques for a satisfactory system. Some of the common manure-handling systems that are used by swine producers to control pollution are described below.

SYSTEM ONE: WASTES FROM HOGS ON PASTURE

Even though there has been a continual trend to raise hogs in some form of confinement, a large percent of the hogs are still raised on pasture. When the hogs are dispersed on pasture in level or rolling land with no drainage stream in the vicinity, the potential for water pollution is minimal. However, when the hogs are so concentrated that the majority of the vegetation is gone and the land slopes to a drainage stream at the bottom of the slope either adjacent or even within the pasture, serious pollution problems can exist, especially during a heavy rain. It is very difficult to intercept and collect this runoff because of location and amount. Some pasture producers will need assistance to help them control this runoff.

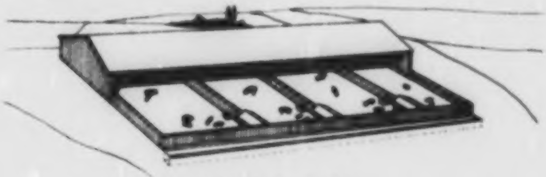


System 1: Hogs on Pasture

SYSTEM TWO: HANDLING SOLIDS

The older conventional method of using solid floors with bedding is not common with the newer production systems, but it is still used by many producers. If hog manure is to be handled as a solid, usually some bedding is required to make it suitable to handle with conventional equipment. A solid feeding floor can be covered with roof or uncovered. An uncovered floor causes serious problems of runoff resulting from direct rain and in some places roof runoff. Serious consideration is being given by producers to have all feeding floors covered by roof to avoid this runoff and, consequently, pollution problems. With a concentrated, uncovered feedlot, one should: first, divert any roof water and any water falling outside the feedlot so that it will not flow across the feedlot, thereby minimizing the quantity of polluted runoff; second, provide a runoff collection and impoundment system that will prevent the entry of the polluted runoff into a stream; and third, provide a method of returning these polluted liquids back to the land in a manner and at a time when runoff will be avoided. Facilities to settle manure solids are usually incorporated into the runoff collection system to separate out the solids.

Solid floors must be scraped once or twice weekly and bedding added when necessary. The Europeans have developed a mechanical gutter cleaner in a dunging alley arrangement to mechanize this undesirable chore, but few have been used in the United States. Usually, our producers arrange the feeding floor so it can be scraped with a tractor with blade. Normally some storage area should be provided for the wastes during the time it is not possible to get on the land to spread it. Some state regulations restricting the spreading of manure on sloping land when it is frozen will complicate this problem.



System 2: Solids

SYSTEM THREE: SLOTTED FLOORS — STORE AND HAUL

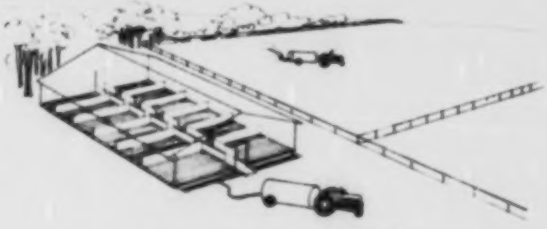
When slotted floors are used for hogs, the manure must be handled as a liquid. Usually there is enough wastage from the waterers so that extra water need not be added to handle the manure as a liquid.

If the swine system is not large, the manure can be stored in a pit under the slotted floors and periodically hauled and spread on the land. The commercial vacuum-tank wagons are popular and minimize the physical labor of hauling manure. One must be sure to ventilate the building when hauling manure for agitation of the liquid manure can release dangerous gases. *Never* enter a storage pit until it is well ventilated.

The major problems with spreading liquid manure on the land are the odors during and immediately following spreading, and the danger of pollution from runoff on rolling land, particularly when rainy weather follows or when the manure is spread on frozen ground. Applying the liquid manure directly into the soil can reduce both problems. The manure can be injected into the soil, deposited in a furrow and plowed under, or spread on the land and disked under. Research is still needed to demonstrate how much manure can safely be applied to different soils and crops.

Several companies have developed attachments for their commercial tank wagons to inject the manure directly into the soil. When the manure is rapidly covered with soil, the odors are almost eliminated, and runoff with the surface drainage is minimized.

Another method of reducing odors in a building or during hauling is to use an odor-depressing or masking agent. Some of these agents are sprayed over the pit in the house; others are mixed with the manure before hauling. Some producers have claimed good results, and others report only fair or poor odor control. The additives must be used according to instructions. The cost to treat any sizable amount of manure can be fairly high. The hog industry desperately needs further development of chemicals to help control and mask the disagreeable odors normally associated with swine production.



System 3: Store and Haul

SYSTEM FOUR: WASTE LAGOONS

Lagoons were first used for the treatment of liquid hog wastes because of their low initial cost, ease of operation, and perhaps more important, the lack of serious alternatives. The first lagoons were developed by a trial-and-error process and were modeled after the municipal aerobic waste-stabilization pond. These lagoons were expected to function like the municipal aerobic waste-stabilization pond, giving complete treatment without any objectionable odors. It did not take long, however, to realize that these "aerobic" lagoons for swine wastes were greatly overloaded. Few, if any, have functioned as aerobic lagoons. Some may turn aerobic in the top layers during the summer daylight hours, but most have been anaerobic.

These lagoons for swine wastes received a great deal of publicity—some of it good, but much of it bad. Most lagoons were too small and had no provision to properly dispose of the overflow which normally developed with constant use. The term "lagoon" has been sadly misused when referring to waste disposal systems. Some people have called any small holding pond or even a holding pit under slotted floors a "lagoon."

Lagoons must be designed either to operate aerobically or to operate anaerobically. Wind action, temperature, depth and amount of sunlight all influence the treatment. It is extremely difficult to design a hog lagoon for aerobic conditions because of the high concentrations of hog wastes. Several lagoons in series are sometimes employed to provide for better treatment. Past experience has shown that lagoon treatment of hog wastes, aerobic or anaerobic, will seldom adequately purify the liquids so that they can be released into a natural watercourse.

Aerobic lagoons (oxidation ponds) have the definite advantage of operating without offensive odors. They should be shallow, not more than 3 to 4 feet deep. They function best under conditions that favor the growth of algae—warmth and sunshine.

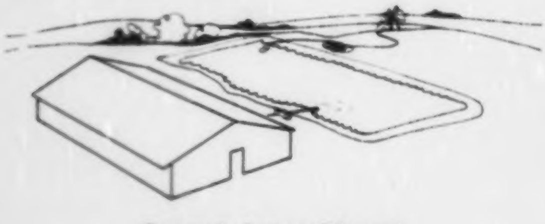
Many of the early lagoons for hog wastes were expected to function as aerobic lagoons, but were usually anaerobic because of overloading. A large amount of surface area is required to operate as an oxidation pond. The suggested surface area for a 3- to 4-ft. deep naturally aerobic lagoon is 2.5 sq. ft. per pound of hog on feed (North Central Regional Farm Animal-Waste Committee, 1971). This would require a 1-acre lagoon for 140 hogs of 125 pounds and 7 acres for 1,000 hogs. Even dispersion of the organic matter throughout so large a lagoon is also a problem. Naturally, aerobic lagoons for the treatment of all wastes from a hog production unit are not economically feasible today.

Aerated lagoons equipped with mechanical aerators to supply additional oxygen have recently been adapted to lagoons for hog wastes. The mechanically aerated lagoon can be used in situations where odors are a problem. Lagoons designed for mechanical aeration may be 15 to 20 feet deep and should provide about 1 cubic foot of lagoon volume for each pound of hog on feed (North Central Regional Farm-Waste Committee, 1971). This treatment is still not adequate to allow the effluent to overflow to a watercourse.

Anaerobic lagoons have the ability to break down organic matter. The usual purpose of anaerobic lagoons is the destruction and stabilization of organic matter, not water purification. The overflow effluent from anaerobic lagoons is highly pollutionable and must be further treated or returned to the land in a proper manner. Often the anaerobic lagoon is used in series with or as the first cell of a 2-cell lagoon with an aerobic lagoon. The solids are settled out and treated in the anaerobic unit, and the overflow effluent is further treated in the aerobic unit.

The major disadvantages of the anaerobic lagoon are the undesirable odors released and the higher temperature required for optimum operation. Undesirable odors are associated with uncontrolled anaerobic systems. With the present public concern for pollution, disagreeable odors are a serious problem. This can be compounded by the fact that in the colder parts of the country, very little, if any, anaerobic digestion occurs during the winter months. In the spring when the temperature finally warms up, the entire manure load deposited all winter must be stabilized. Strong odors persist for some time until the system has had time to stabilize this accumulated load. Today, the use of anaerobic lagoons for the treatment of all wastes from a production unit is limited because of the odor problem.

Further study is needed in using the anaerobic lagoon for treating and storing hog wastes. The construction costs and operational features are very favorable. Possibly an inexpensive cover could be used to control odors and filter the air that is released.



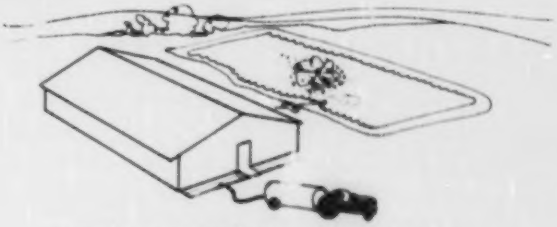
System 4: Lagoon Disposal

SYSTEM FIVE: COMBINATION OF HAULING AND LAGOON

A lagoon may be practical for treating all the wastes from a small farrowing house or a farrowing-nursery combination. Whenever large amounts of manure must be disposed of, total treatment by lagoon is not usually feasible because of the large area required by the lagoon and the large amount of water necessary.

The combination of hauling part of the manure and using the lagoon for the liquid overflow has worked quite well for many of the producers. Most of the manure is hauled to the field when land is accessible and weather permits. When manure can't be hauled on the fields or when the operator is busy with more demanding activities, the liquids are allowed to overflow into the lagoon and the solids remain in the pit to be hauled away later. Some agitation may be required to remove the solids after they have been allowed to build up for a period of time.

This combination of hauling and lagooning allows the producer to utilize some fertility value from the manure and haul the manure when there is less demand for his time. It also takes a major portion of the loading off the lagoon.

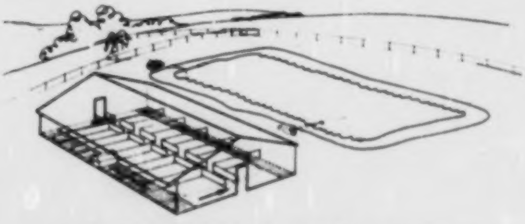


System 5: Combination: Haul & Lagoon

SYSTEM SIX: OXIDATION DITCH

The oxidation ditch is a mechanical method of aerobically treating liquid wastes. It has attracted much attention because, like all aerobic treatments, it is essentially odor-free. A confinement swine building with a properly operating oxidation ditch will have essentially no odors from the treated stored wastes. Other advantages are reduced odors during field spreading of the treated effluent, easier handling of solids, and a reduction in the amount of manure to be handled because of some evaporation. The major disadvantages to producers are higher initial cost of construction for facilities and equipment, a sizable operational cost, and the required close management necessary to assure proper operation.

A confinement swine building using an oxidation ditch usually has a manure storage pit under the slotted floors constructed so there is a continuous channel. An aeration rotor churns the liquid wastes, mixing in air that supplies the necessary oxygen for the aerobic bacteria. The action of the rotor also keeps the wastes circulating so that all the solids are kept in suspension. The rotor must be operated continuously to maintain aerobic conditions. It is usually best to maintain a constant liquid level in the ditch so that the rotor level need not be adjusted. A lagoon can be provided to take the treated liquid runoff, or the liquid can be collected in a storage tank and hauled. The liquid effluent from an oxidation ditch cannot be run off in a tile line or an open watercourse because it will not be adequately purified to meet pollution control standards. Irrigation can be used to return the treated effluent back to the land either from a storage pit or a lagoon. Normally, the solids should be settled out and handled separately before running the effluent to a lagoon or to an irrigation system.



System 6: Oxidation Ditch & Lagoon

SYSTEM SEVEN: HYDRAULIC MANURE REMOVAL

Removing the swine manure hydraulically from the building has been used in both Europe and the United States. Iowa State University (Smith and Hazen, 1967) has shown that the flushing-gutter system that they have developed and tested for several years can minimize odors within a confinement building when the manure is flushed from the house several times a day. The hydraulic system can be used to wash a shallow gutter (3 to 5 inches deep) or beneath slotted floors. Most odors are eliminated because the manure is washed from the building into a lagoon or storage pit before it has had time to turn septic. Usually, a reservoir of water is stored at one end of a gutter. Several times a day this water is rapidly released in the gutter, hydraulically washing the wastes (liquids and solids) out of the house. It has been shown that periodically wetting the gutter combined with floor feeding actually influences the pigs to dung in the gutter and keep the major portion of the pen clean. Flushing under slotted floors would be required in farrowing houses and nursery buildings because of the necessity for dry conditions in these units.

Because of the large demand for water and the excessive amount of liquid wastes that result, normally some type of recirculatory system is required. Iowa State University has shown that flushing a gutter with recirculated water that has received treatment in a lagoon and then an oxidation ditch has no detrimental effect on the pigs even though they have free access to the recycled water.

Other Methods of Swine Waste Disposal

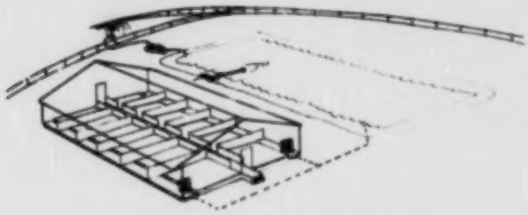
There are several other methods of waste disposal, but most show very little promise for use with swine wastes.

Dehydration appears to have little value for the disposal of swine manures unless only the solids are handled with liberal amounts of bedding. Swine manure as it is produced in a confinement house contains 85% water and 15% dry matter. It would be quite expensive to dry manure to 90% dry matter and 10% moisture and then end up with a product that had a questionable market value. Any condensing of the solids would still leave the disposal problem of the liquids.

Incineration also appears to have little to offer for the disposal of swine manure. It has been explored for poultry manure, but the high moisture content of swine wastes makes this method seem impractical.

Composting is not directly suited for the disposal of liquid manure. It would be better suited for the disposal of the solids collected in a settling tank. The swine wastes would need to be mixed with dry material such as chopped straw or waste wood products. Composting requires time and the equipent costs are beyond the reach of most swine producers. Composting may offer a possibility if large amounts of swine manure are collected along with other waste products.

Refeeding swine wastes has recently created much interest. Current research shows very high nutritive values for some parts of treated swine wastes. Since refeeding is being discussed in another paper, it will not be covered in this paper.



System 7: Flushing Gutter

SUMMARY

Swine products seem to be at a crossroads in development of future production systems. Much progress has been made in the areas of nutrition, mechanization, genetics, and environmental control to help develop profitable production systems for the average farmer. As the public concern over pollution continues and new and more restricting regulations covering the handling and disposal of livestock wastes are enacted, new methods of adequately and economically disposing of livestock wastes must be developed to help the producer. Either the producer will have to increase size to justify the costly handling and treatment facilities, which will force the closing of smaller units, or the public's cost for pork must be raised to cover these increased production costs.

REFERENCES

1. Day, D. L., et al. (1971). Animal and Human Metabolic Wastes. Agricultural's Role in Environmental Quality. Proc. of the 1st Allerton Conference, Dec. 1970. Coll. of Agr., Univ. of Ill. at Urbana-Champaign. pp. 23-25.

2. McKinney, R. E. (1970). Manure Transformations and Fate of Decomposition Products in Water. In "Agricultural Practices and Water Quality," et. T. L. Willrich and G. E. Smith, The Iowa State Univ. Press, Ames, Iowa. pp. 256-263.

3. Midwest Plan Service (1969). Handling Swine Manure. AED-11, Ames, Iowa. 4 p.

4. Miner, J. R., and T. L. Willrich (1970). Livestock Operations and Field-Spread Manure as Sources of Pollutants. In "Agricultural Practices and Water Quality," et. T. L.Willrich and G. E. Smith, the Iowa State Univ Press, Ames, Iowa. pp. 231-240.

5. Muehling, A. J. (1969). Swine Housing and Waste Management—A Research Review. A. Eng. -873, Dept. of Agr. Eng., Univ. of Ill. at Urbana-Champaign. 91 p.

6. Muehling, A. J. (1971). Handling Swine Manure to Avoid Pollution. Paper prepared for 1971 Swine Seminars, Agr. Eng. Dept., Univ. of Ill. at Urbana-Champaign. 6 p.

7. National Pork Producers Council (1970). Guidelines for Pork Producers for Use to Preserve Environmental Quality. Prepared by NPPC Environmental Quality Committee, Des Moines, Iowa. 4 p.

8. North Central Regional Farm Animal-Waste Committee (1971). "Farm Animal-Waste Management," et. J. R. Miner. Iowa Agr. and Home Economics Special Report 67 (North Central Regional Pub. 206), Iowa State Univ., Ames, Iowa. p. 21.

9. Smith, R. J., and T. E. Hazen (1967). The Amelioration of Odor and Social Behavior in, Together with the Pollution Reduction from, a Hog House with Recycled Waste. ASAE Paper 67-434. 19 p.

RECYCLING OF ANIMAL WASTES

ROBERT G. YECK AND PAUL E. SCHLEUSENER

Chief, Livestock Engineering and Farm Structures Research Branch,
Agricultural Engineering Research Division, Agricultural Research
Service, U.S. Department of Agriculture, Beltsville, Maryland 20705.
and
Research Management Specialist, Cooperative State Research Service,
U.S. Department of Agriculture, Washington, D.C. 20250.

Today there is much concern over upsetting the Earth's delicate ecological balance. We seek the ideal of having all earthly activities fit into one mammoth recycling system. Some activities may form their own closed system; others may interact with other activities before a cycle is complete. Let's take a look at animal production systems and how they fit into a cycle.

Many people visualize animal production as a simple system (Figure 1). Feed and water are the inputs and animal product and waste are the outputs. Such a system must interact with other activities in order to close a cycle. It is inefficient as it fails to take advantage of the feed value left in waste and the wastes are considered an environmental contaminant.

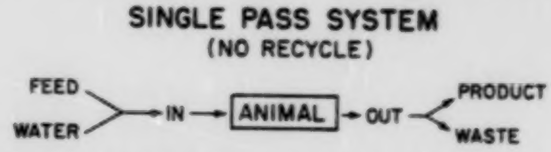


Figure 1: An Animal Production System Without Waste Recycling.

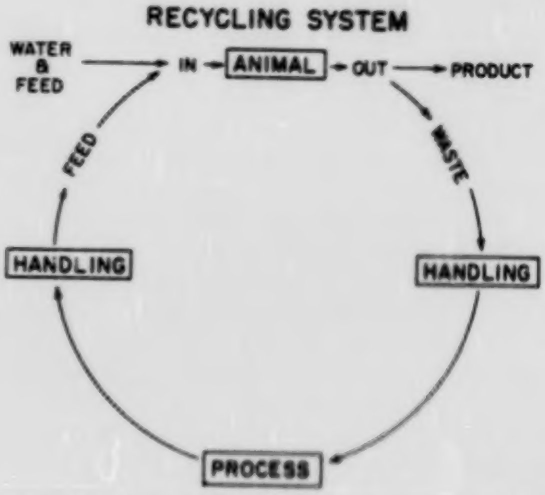


Figure 2: An Animal Production System With Waste Recycling.

We need to think in terms of a system that provides recycling such as shown in Figure 2. All wastes are completely recycled. Although 100 percent recycling is seldom attained, it can be the ideal by which we measure success. Some recycling systems have no intermediate steps of handling and processing. The animal eats its own feces. Many of you have seen chickens scratching in their litter. Poultry litter has been identified as a source of B-complex vitamins. However, since similar benefits can be

Preceding page blank

attained by fortifying the feed and there are diseases and other hazards associated with wastes, the practice has been discouraged.

The nutritional value of manure has been recognized for years. A 1917 USDA Farmers' Bulletin[1] listed among the merits of a hog, its ability to utilize the feed that cattle failed to digest. Increased profits from this activity were $6 to $9 per steer ($20 to $30 in terms of today's dollar). This is not a complete cycle in the sense of Figure 2 as a second type of animal is added. It, however, is an important historical illustration of a refeeding practice.

The injection of a process into the cycle would seem to be a complicating factor. Yet, for centuries, it was the "natural system." Flocks owned by nomadic tribes grazed on pastures and their wastes were returned directly to the land. Weathering and biological degradation released plant nutrients to the soil and to the atmosphere. Through their roots and leaves plants used these for additional growth. When the animal consumed the new growth, the cycle was completed. In some cases the cycle was interrupted by avian species scratching in the wastes for unused feed or insects. The insects themselves reduced the wastes.

Land recycling is currently the best available practice and will probably continue as a prime method for recycling for several years. It is, however, a costly process when one considers the land costs, and all other manipulations that are required. The wastes must be handled between the point of discharge and the point of reuse. This includes collection, transport, storage, spreading, and working into the soil. The land process itself requires planting, tilling, and harvesting. Insect and odor control is often needed. The return process includes transport, storage, mixing into a ration, and delivery to the animal. As with any process there is some sloughing of wastes along the cycle. Some of the gases are lost, some of the nutrients are leached beyond the root zone or eroded away, and some of the residues are not useful for crops. Land recycling is also difficult to use where enterprises are large, land areas are scarce or the public is unwilling to accept the odors that may occur with land applications. We are also becoming concerned with toxic effects of overloading lands with animal wastes beyond the degrading capability of the soil and the utilization capability of the crops grown thereon. A proposed regulation for the Province of Ontario, Canada, establishes a land availability standard for one acre per cow for less than 40 cows and one-half acre per cow for larger enterprises. This means that a 100,000 head beef feedlot would need about 50,000 acres for disposal. Many climatic and cropping situations will permit exceeding these drastic restrictive limitations and research is expected to further improve land application technology but substantial land areas will remain a basic requirement. There is certainly a need for alternative recycling techniques.

Many alternative recycling processes have been proposed. Some have feed as their only product, some produce both feed and nonfeed byproducts, some produce only nonfeed byproducts such as methane gas and industrial chemicals, and others involve animal wastes to improve some other process. Water recovery is an important "plus" for some systems.

Refeeding processes are considered sufficiently important to warrant the full attention for the remainder of this presentation. The gross fecal and urine wastes from meat animals, dairy cattle, and poultry on farms and ranches in the United States have a crude protein equivalence of about 40 million tons per year. Of course, not all wastes are collectable, and some nitrogenous losses occur. Assuming that one-third of the nitrogen from these wastes would be available for processing into feed, we would have a crude protein equivalence as great as the total annual soybean production—more than 12 million tons of protein. That is quite a resource to help feed the additional 75 million people that we expect in the U.S.A. less than 30 years from now. The value of the comparable crop of soybeans when harvested would be more than 2.5 billion dollars.

Let us compare this to land application. Assuming $2.50 per ton as crop fertilizer value, the same amount collected, and the same losses as in the foregoing example, one could expect that animal wastes used as manure would only return one-half as much as manure used as feed.

Broad generalizations need to be used cautiously as the actual feed value of a specific animal waste would be dependent on the kind of waste used, the specie of animal to which fed, and the process used. Ruminants generally can make better use of animal wastes than animals with single stomachs and the digestibility of animal wastes can be greatly improved with chemical hydrolysis. The total protein output for any process will, of course, be limited by the nitrogen that was initially in the animal waste.

Protein is the main value of animal waste but there are other ration constituents, too. Vitamins have already been mentioned. Other constituents are: Calcium, Phosphorus, starch, and structural polysaccharides. Anthony[2], Fontenot, et al[3], Long, et al[4], and Chance[5], are sources of additional information on the chemical composition of animal wastes.

There may be some undesirable constituents in animal wastes, too. The possible presence of disease organisms has been mentioned. Other potential problems are nonnutritive feed additives. Some are listed in Table 1. Some of these are discussed in detail according to class of animals by Smith, Calvert, Frobish and Dinius[6]. The additives of greatest current concern are antibiotics, arsenicals, and hormones.

TABLE 1

NONNUTRITIVE FEED ADDITIVES THAT POSE POTENTIAL PROBLEMS IN RECYCLING ANIMAL WASTE AS FEED. CITED FROM SCOTT, NEISHEIM, AND YOUNG (1969)[7]

Pellet binders
Flavoring agents
Enzymes
Antibiotics, arsenicals, nitrofurans, (low level feeding)
Antifungals
Broad-spectrum, absorbable antibiotics (high level therapeutic use)
Chemicals used to potentiate curative properties of antibiotics
Coccidiostats
Worming drugs
Antioxidants
Carotenoid sources
Hormones
Reserpine, aspirin, and tranquilizing drugs
Larvicides

Pesticides are also of concern. There will need to be assurance that no hazardous pesticides could get into the food chain either through pesticide sprays reaching the wastes or through the use of larvicides. Table 2 from Miller[8] indicates some of the insecticides with registrations for larvicidal use. It is worthy to note that there would be no need for the larvacides if wastes weren't left to accumulate where insects could get to them such as is possible in a refeeding process.

Let us now turn to a discussion of some of the processes by which the feed value of animal wastes may be better realized. Some that have been proposed are shown in Table 3.

Dr. L. W. Smith, et al[6] prepared an excellent review of experiments on feed reuses of farm animal manures. Biological processes can double the concentration of protein. The protein will probably have to be separated from the masses to obtain maximum benefit before refeeding. Such concentrations will be at the expense of other digestible ingredients and lignin will be concentrated.

Animal wastes have been successfully recycled to either the species of animal that produced them or to other species by one or more of these processes. Ruminants are considered the best candidates for utilizing animal wastes in their entirety but poultry have done well, too, on their own fecal wastes.

Drying animal wastes promotes easier handling. It may be accomplished with or without supplemental heat. Drying without supplemental heat has been successful using: (a) natural drying like the field-curing of hay; (b) forced air drying with blowers; and (c) dry materials blended with animal wastes. Adequate palatability is apparently obtained with these techniques. The addition of supplemental heat hastens drying and pathogenic microorganisms are killed if exposed to proper temperature for an adequate length of time. The rules of pasteurization apply (140°F for 20 minutes with less time required for higher temperatures).

Dehydrated poultry wastes have been successfully fed to cattle, sheep and chickens. Zindel and Flegal[9] have reported that poultry feces could be recycled more than once with no apparent loss in effectiveness as feed. It is understood that these tests on repetitive re-

TABLE 2

INSECTICIDES WITH REGISTRATIONS FOR LARVICIDAL USE ON ANIMAL MANURE(1)

Compound	Type registration								
	Poultry			Beef Cattle			Dairy Cattle		
	NF(2)	Extended(3)	FA(4)	NF(2)	Extended(3)	FA(4)	NF(2)	Extended(3)	FA(4)
Calcium arsenate	X	—	—	—	—	—	—	—	—
Phenothiazine	—	—	—	—	X	X	—	X	X(5)
Dieldrin	X(6)	—	—	—	—	—	—	—	—
Dichlorvos	—	X	—	—	X	—	—	X	—
Diazinon	X	—	—	X	—	—	—	X	—
Dicapthon	X	—	—	—	—	—	—	—	—
Zytron	X	—	—	—	—	—	—	—	—
Dimethoate	X	—	—	X	—	—	X	—	—
Ronnel	—	X	—	—	X	X	—	X	—
Trichlorfon	X(6)	—	—	—	—	—	—	—	—
Rabon	X	—	—	X	—	—	X	—	—
Coumaphos	—	—	—	—	—	X	—	—	X

(1) Data supplied by Pesticide Regulations Division, formerly with ARS, USDA, now with Environmental Protection Agency.

(2) Insecticides checked in these columns can be applied directly to manure, however, the manure cannot be used on food crops.

(3) Insecticides checked in these columns can be applied directly to manure and the manure can be used on food crops until February 1971.

(4) Insecticides checked in these columns can be fed to the species indicated. With the exception of coumaphos, these registrations are valid only until February 1971.

(5) Nonlactating dairy cattle only.

(6) Battery poultry houses only.

TABLE 3

REFEEDING PROCESSES

Drying
Cooking
Fumigation
Chemical
Washing
Pyrolysis
Ensiling — Fermentation
Composting
Lagooning
Hydroponics
Insect
Earthworm
Fish
Algae
Yeast
Single Cell Protein

cycling are continuing with success. They had success with replacing 20 percent of the ration with dehydrated feces. Dehydrated poultry litter can also be used to replace 25 percent of the rations for ruminants with no loss of performance. A 50 percent replacement will probably result in lower acceptance and performance.

Cooking under steam pressure prevents some of the crude protein loss of hot air drying. This process has been used successfully with broiler litter at the Virginia Polytechnic Institute and State University[10]. Garbage cooking technology would perhaps be applicable but relatively little is known about its economics and effectiveness for animal wastes.

Fumigation with ethylene oxide was tried in conjunction with the Virginia cooking tests. Its feasibility remains far from proven.

Chemical treatments[11] using eleven different chemical compounds have been tested for their effectiveness in improving digestibility. Of the eleven, sodium hydroxide, sodium peroxide, sodium chlorite, and sodium sulfite were the most effective. The first two resulted in large decreases in undigested plant cell walls, cellulose, hemicellulose and lignin contents.

The addition of 3 percent sodium peroxide to feces significantly increased its digestibility. The product was accepted well by sheep as 25 percent of a corn silage-treated feces ration. Intake was less with a 50-50 mixture of corn silage and feces. The chemical treatment of animal wastes needs more study and development before it can be fully evaluated as an alternative or component in animal waste recycling processes.

Pyrolysis is chemical decomposition by heat. It has been proposed as a means of separating useful compounds in animal wastes. Once the process is in operation animal wastes can supply much of the energy needed for heating. This is one reason proponents of pryolysis for urban wastes are interested in adding animal wastes to their urban waste inputs.

Anthony[12] tried *washing* wastes from feedlots of confined yearling steers. He repeatedly mixed the samples with water, allowed settling and poured off the liquid. The remaining fecal residues were successfully fed to steers and bulls. The process was inefficient and his efforts are now directed toward ensiling.

The other processes of those that are listed in Table 3 involve biological activity for the alteration or change of the state of animal wastes. *Ensiling* technology for grasses appears applicable as a process for animal wastes. Its feasibility has been demonstrated for poultry wastes and cattle wastes. Anthony[2] prepares wastelage (silage) from a 57:43 ratio of fresh manure to ground grass hay. Steers gained well on a 40:60 ratio of this wastelage and corn. Ensiling, although not yet fully proved, would seem to have an excellent chance of being adopted as an acceptable animal waste refeeding process. It should be noted that there are possibilities for using other fermentation processes but they, too, are in exploratory stages.

Composting has much promise as a component of a refeeding process. It is a method of reducing moisture content and volume with little odor (if correctly managed). Sufficient heating may occur to destroy pathogenic organisms. It is doubtful that it will become an adequate and complete process in itself for safe refeeding of animal wastes.

Lagooning is the process of collecting and holding animal waste slurries (extra water may be required) until they are degraded or other disposal is accomplished. The sludge that settles in the bottom of these lagoons is rich in nitrogenous compounds. In 1955, Adams[13] found that steers readily ate 1 lb. per head daily of dried sewage sludge. Studies are underway in Minnesota to recover, dewater, and feed sludge from an aerated dairy barn oxidation ditch. It is too early to report results but the technology to simply dewater the sludge is a major problem.

The biological activity in the sludge process can be refined by selective use of bacteria and the control of thermal conditions to optimize the end product that is desired. Too little is known about this innovation to predict its utility.

The remaining biological processes are similar to land recycling in that a biological form consumes animal wastes and the consuming organisms are harvested. *Hydroponics* might be considered as crop recycling without soil. It has been used primarily to remove nutrients from the liquid effluent discharges of solid waste treatment systems. Eby[14] has tested a prototype system using grass as the crop and there is some current research at Iowa State University on using water hyacinths. Relatively large amounts of space are required and the crops must be protected from frost. Much remains to be done in this area. Hydroponics will probably not come of age as a total animal waste process system for many years but it has immediate application as a tertiary treatment.

Insect culture has been applied to fecal wastes from caged poultry operations. The wastes are seeded with fly eggs, the larvae digest the waste and are harvested as pupae[15]. The pupae are an excellent source of protein. They have successfully replaced protein in poultry rations. The residue is dry and quite free of odor. Further studies[16] have shown that the emerging housefly is perhaps even a better feed. This should not be surprising as insects are a "natural" food of birds. Current efforts are toward developing practical technology by which the process can be tested on a field scale. It would appear to have its best application in conjunction with large caged layer operations that are located in densely populated areas.

Earthworm culture, like insect culture, would provide a "natural" food for poultry. The fishermen among us who grew up on farms will no doubt remember that the best source of worms was around the manure pile. To date, no practical system has been demonstrated.

Fish culture for food is popular. It could be used as a refeeding process as catfish have been raised on diets in which 50 percent of the ration was feedlot manure[17]. One could hitchhike on the fish meal technology and explore the possibility of using it as a basis for a refeeding process. A major constraint, however, is that such a process requires a high volume input. Current technology anticipates about 1500 pounds of fish per acre as an annual harvest. Tremendous acreages would be required to keep a fish meal plant in operation.

Algae grown on sewage have been fed to pigs, cattle and sheep[18]. The harvested algae apparently require pelleting in order to gain acceptance in the ration. The applicability of this process to refeeding animal wastes remains to be determined.

Yeast was grown on fluidized and aerated cattle manure by Anthony[2]. The applicability of this process for refeeding to farm animals is yet to be determined. Other biological processes would seem to have more promise of success.

Single cell protein culture is related to the selective bacteria concept described under the sludge process. It is accomplished by controlling the environment and using the most efficient microorganism for conversion. There is some industrial activity on this process but nothing to report at this time.

SUMMARY

One can easily become enthused over the newer processes for recycling animal wastes as animal feed. Caution, however, must be used in implementing them. The state of the art of most systems is very exploratory. Livestock producers must check with their animal product processing industries and regulatory authorities to be sure that animal products produced with feeds from a specific process are acceptable at the market place.

Land recycling of animal wastes with the crop returned to the animal is the traditional and most accepted process. It is, however, not as feasible as it once was. When viewed in its entirety it is a costly process and land is not always readily available. The 40 million tons of crude protein equivalence that is associated with United States' dairy, meat, and poultry production is a valuable resource. Eventually, one or more of the sixteen other processes that were discussed might very well develop into a more economical and direct recycling system than land recycling.

REFERENCES

1. United States Department of Agriculture. 1917. Swine Management. Farmers Bulletin 874.

2. Anthony, W. B. 1969. Cattle manure: Reuse through wastelage feeding. Proceedings of the Conference on Animal Waste Management, Cornell University, Ithaca, N.Y., p. 105.

3. Fontenot, J. P., Bhattacharya, A. N., Drake, C. L., and McClure, W. H. 1966. Value of broiler litter as feed for ruminants. Management of Farm Animal Wastes (Proceedings National Symposium, May 5-7), ASAE, St. Joseph, Michigan, p. 105.

4. Long, T. A., Bratzler, J. W., and Frear, D. E. H. 1969. The value of hydrolyzed and dried poultry waste as a feed for ruminant animals. Proceedings of the Conference on Animal Waste Management, Cornell University, Ithaca, N.Y., p. 98.

5. Chance, C. M. 1965. Non-protein nitrogen and poultry litter in ruminant diets. Proc. Maryland Nutr. Conf., March 18-19, p. 8.

6. United States Department of Agriculture. 1971. Animal waste reuse—nutritive value and potential problems from feed additives: A Review. ARS 44-224.

7. Scott, M. L., Nesheim, M. C., and Young, R. J. 1969. Nutrition of the chicken. M. L. Scott and Associates, Ithaca, N.Y.

8. Miller, R. W. 1971. Fecal residues from larvicides—poultry and cattle. Animal Waste Reuse—Nutritive Value and Potential

Problems From Feed Additives, A Review, ARS 44-224, p. 33.

9. Zindel, H. C. and Flegal, C. J. 1969. Processed poultry excreta recycled as a feed ingredient. Proc. 1969 National Poultry Litter and Waste Management Seminar, Salisbury, Md., Sept. 29-30, p. 103.

10. Fontenot, J. P., Webb, K. E., Jr., Harmon, B. W., Tucker, R. E., and Moore, W. E. C. 1971. Studies of processing, nutritional value and palatability of broiler litter for ruminants. Presented at International Symposium of Livestock Wastes, April 19-21, p. 88. To be published in Proceedings of Symposium by ASAE, St. Joseph, Mich.

11. Smith, L. W., Goering, H. K., and Gordon, C. H. 1969. Influence of chemical treatments upon digestibility of ruminant feces. Proceedings of the Conference on Animal Waste Management, Cornell University, Ithaca, N.Y., p. 88.

12. Anthony, W. B. 1966. Utilization of animal waste as feed for ruminants. Management of Farm Animal Wastes (Proceedings National Symposium, May 5-7), ASAE, St. Joseph, Michigan, p. 109.

13. Adams et al. 1955. Ill. Journal Animal Science, 14, pp. 1191-1192, cited by Morrison, Feeds and Feeding.

14. Eby, Harry J. 1966. Evaluating adaptability of pasture grasses to hydroponic culture and their ability to act as chemical filters. Management of Farm Animal Wastes (Proceedings National Symposium, May 5-7), ASAE, St. Joseph, Michigan, p. 117.

15. Calvert, C. C. 1962. Vitamin E., selenium, and antioxidants in prevention of vitamin E deficiencies in the chick. Proc. Cornell Nutrition Conference for Feed Manufacturers, p. 52.

16. Calvert, C. C., Morgan, N. O., and Eby, H. J. 1971. Biodegraded hen manure and adult house flies: Their nutritional value to the growing chick. Presented at International Symposium of Livestock Wastes, April 19-21, p. 94. To be published in Proceedings of Symposium by ASAE, St. Joseph, Michigan.

17. Durham, R. M., Thomas, G. W., Albin, R. C., and others. 1966. Coprophagy and use of animal waste in livestock feeds. Management of Farm Animal Wastes (Proceedings National Symposium, May 5-7), ASAE, St. Joseph, Michigan, p. 112.

18. Hintz, H. F., Heitman, H., Jr., Weir, W. C., Torell, D. T., and Meyer, J. H. 1966. Nutritive value of algae grown on sewage. J. Anim. Sci. 25:675.

REGULATORY ASPECTS OF RECYCLED LIVESTOCK and POULTRY WASTES

JACK C. TAYLOR

Chief, Non-Ruminant Nutrition Branch
Division of Nutritional Sciences
Bureau of Veterinary Medicine
Department of Health, Education and Welfare (FDA)

The current Federal Food, Drug and Cosmetic Act of 1938 prohibits interstate commerce in adulterated or misbranded foods and drugs.[1] Thus, any goods that have not been shipped or received in interstate commerce are not subject to the Act. The term "food" as defined in the Act means articles used for food or drink for man or other animals. Therefore, any ingredient used in the diet of animals comes under the Act and this would include animal, human and industrial wastes. The Act does not distinguish between food used solely for animals as opposed to food used solely for man. It deems a food adulterated if that food contains any poisonous or deleterious substance which may render it injurious to health, if it contains any food additive which is unsafe, or if it consists in whole or in part of any filthy, putrid or decomposed substance.

The term "food additive" means any substance the use of which may be expected to result in its becoming a component of food, such substance not being generally recognized as safe among experts qualified by scientific training and experience to evaluate its safety. In 1958 Congress provided a system by which the safety of a food additive may be scientifically established. Section 409 of the Act provides for the submission of a petition proposing issuance of a regulation prescribing the conditions under which a food additive may be safely used. Probably it should be clarified that the term "food additive" should not be confused with a feed ingredient which is generally recognized as safe and requires no regulation for its safe use. It is only when a feed ingredient becomes adulterated and is involved in interstate commerce that FDA becomes involved. Some recent examples are aflotoxin in cottonseed meal, mercury in fish and poly-chlorinated biphenyls (PCB) in fish meal.

On September 2, 1967, the Food and Drug Administration published Section 3.59, which is a formal statement of policy under Subchapter A, Title 21 of the Code of Federal Regulations.[2] (This regulation has currently been recodified in Subpart B of Part 135, Section 135.104.) This section states that the FDA has not sanctioned and does not sanction the use of poultry litter as a feedstuff for animals. The reasons given are that poultry litter may be expected to contain drugs and antibiotics or their metabolites and that disease organisms may be transmitted from poultry to other animals

Preceding page blank

through the use of poultry litter in animal feed.

Since publishing this policy statement, FDA has received numerous inquiries and requests for information on the use of animal wastes as potential sources of animal feed. The wastes are of two general types, namely (1) material partially processed by drying or ensiling, (2) products processed by digester-type systems using bacteria, algae, fly larva or chemicals.

Those of us in the Bureau of Veterinary Medicine involved with recycling wastes through food producing animals have devoted considerable time and thought to the problem and have formed the following conclusions:

1. Animal, human and industrial wastes prepared for recycling through food producing animals may probably best be handled in a manner similar to that used for animal by-products which are presently prepared as feed for animals. Examples of these are blood meal tankage, feathers and poultry by-product meal which come under the Voluntary Inspection and Certification Service administered by the U.S. Department of Agriculture.[3]

2. Although the policy statement 3.59 is directed specifically to poultry litter, we consider it to be a general statement applying to all waste products proposed as a component of the diet of animals.

Harmful levels of organic substances may be present either as an inherent part of the waste material or as a result of processing the material. Sewage disposal plants may accept industrial chemical wastes for disposal thus risking harmful contamination. Similarly, individuals may at any time introduce potentially harmful substances into the sewage system. At least with poultry litter we have some assurance that the material will likely not contain, for example, drugs other than those fed to the poultry. The main problem here is determining the safety of this material when recycled through other species.

Based on these conclusions, FDA suggests that the following information is needed in order to express a further opinion on the use of various waste products as sources of animal feedstuffs. It is realized that all of the points raised may not necessarily apply in all situations.[4]

1. The source of the raw materials.
2. A stepwise description of the processing, manufacturing methods, and the analytical controls.
3. A description of the end product and its intended use.

We believe that from the above information we can decide whether or not we will need information on the following criteria:

1. The use level of the product should be shown safe for consumption by the target species.
   a. The material should not contain harmful levels of disease producing organisms or toxic metabolites.
   b. The levels of pesticides, drugs, heavy metals, and any substance contained in the material should be shown safe for consumption by the target species.
2. No harmful residues from drugs, pesticides or any other substances, nor from their metabolites, degradation products, or other derivatives can occur in the edible tissues or by-products of the animals consuming the product.
3. The material should be reasonably uniform for purposes of accurately labeling its contents.

If the information submitted to FDA shows the presence of tissue residues resulting from inclusion of waste products in the diet, then the Division of Toxicology, Bureau of Foods, will be asked to review and comment on this information. Arsenic is an example of this type of problem. Arsenicals are routinely incorporated in the diets of poultry and swine and at the present time the regulations provide for a tolerance of arsenic residues in the edible tissues of these species, but not in cattle. If wastes from poultry and swine contain arsenic residues and these wastes are fed to cattle, this practice could result in levels of arsenic in the edible tissues of cattle. Should this occur, two alternatives exist:

1. Cattle can be fed a diet free of added arsenic (a withdrawal diet) for a period of time prior to slaughter in order to allow the arsenic residues to be cleared from the tissues.
2. FDA could be petitioned to provide for a tolerance for arsenic residues in the edible tissue of cattle.

The Bureau of Veterinary Medicine has received authorization to contact representatives of the Environmental Protection Agency, the

U.S. Department of Agriculture, the National Institutes of Health, and the Association of American Feed Control officials in an attempt to better coordinate the efforts of the agencies we think will be concerned with recycling waste products through animals. We feel that the public can best be served if the efforts of these agencies are coordinated and aimed at a common goal. FDA does not have grant-in-aid funds available for research with waste products. The extent of FDA's financial participation in recycled research will likely be the ongoing two-year contract which was established in 1970. The objectives of this research are, (1) analyzing the nature and extent of drug residues in poultry litter, (2) studying the effect of processing on these residues and, (3) determining whether or not certain drug residues in the litter will accumulate in the tissues of ruminants consuming the diets. This research was made possible with a nominal outlay of funds since samples of both litter and animal tissue were already available as a result of previous studies at the contract institution.

When we have received information sufficient to make a decision that a specific waste product is safe for consumption by the target species and that meat and by-products from animals consuming the product are safe for consumption, we will be in a position to review our objections to the use of animal wastes in livestock diets.

The following standards may possibly aid in describing a waste product proposed for recycling through animals.[4]

1. Free of extraneous materials such as wire, glass, nails, etc.
2. Shall not contain harmful levels of organic or inorganic substances or disease producing organisms.
3. Of sufficient dry matter content for preservation.
4. Labeled for minimum percent protein, maximum percent fat and maximum percent fiber.

The types of information desired on waste products is similar to that required for other products submitted to FDA for review. The three basic categories of information are (1) establishing nutritive value (or efficacy), (2) determining safety to animals, and (3) determining that food from animals consuming such products is safe for man. This last part can be further subdivided into two categories, namely (1) determining if tissue residues exist, and (2) if tissue residues do exist, determining if they are safe.

It is realized that establishing the nutritive value of a product is of necessity the first step in a research program concerned with waste type materials. If animals will not consume the product or if it is found to have no nutritional value, then there is no need for further research with the product. We feel that it is important for those conducting research with these materials to realize that information on safety to animals and safety to man is required by FDA in order that research plans may incorporate these phases early in the program.

While the Code of Federal Regulations includes a formal statement of policy regarding the use of poultry litter as a feedstuff for animals, it should not be construed to mean that research in this area is discouraged. It does, however, stress the need for information on animal and human safety when waste products are proposed for use in the diet of livestock. At this time, FDA does not have sufficient information to justify a modification of its present regulation.

REFERENCES

1. Federal Food, Drug, and Cosmetic Act. January 1971. U.S. Government Printing Office Washington, D.C. 20402.

2. Code of Federal Regulations, Title 21, Food and Drugs, 1971. U.S. Government Printing Office, Washington, D.C. 20402.

3. U.S. Department of Agriculture, Agricultural Research Service, 1969. Health Requirements and Regulations Governing the Interstate and International Movement of Livestock and Poultry.

4. Taylor, Jack C. 1971. Regulatory Aspects of Recycled Livestock and Poultry Wastes. Proceedings of International Symposium on Livestock Wastes, Ohio State University, In Press.

WATER POLLUTION AND THE FARMER

HONORABLE FRED SCHWENGEL

Congressman, First District, State of Iowa

Until recent years, pollution, especially as it concerned agriculture, has received little attention. Things are different now. There is intense concern about the quality of our environment everywhere in our country. Every major popular publication carries the gospel of Environmental Righteousness. Books have been written like "The Greening of America" and many television programs have been devoted to the subject of pollution solution. In every educational institution subjects are taught and courses are offered to help us understand pollution and its solution. The definition of pollution that has been suggested reads, "An unfavorable alteration of our surroundings manifested by a degradation of the physical, chemical, and biological characteristics of the associated land, water, and air." That certain grave aspects of such degradation exist in our environment today can not be denied. We are all recognizing now the need for change in personal habits, industrial processes, governmental practices, and a better and more adequate soil management program.

It should be noted, and we in the Committee after many days of hearings now know, that pollution caused by agricultural activities is only one of the more important facets of the total national pollution problem. Pollution from municipalities, industries, mining, marine activities, natural pollution, governmental pollution, and pollution from accidental spills of oil and hazardous materials are examples of other sources of wastes that pollute our environment. These, too, are being noted and dealt with in the Congress.

Agriculture is involved and its total problem is a monumental one. First, because many of its wastes do adversely affect water quality, and second, because it needs high-quality water for its own uses. Keeping agricultural wastes out of natural waters presents formidable and complex problems, and technology often is not available to do the job adequately. Fortunately, however, thanks to the land grant colleges, to the concern of farmers, to the interest of industry, most of agriculture's water quality problems do not appear, and I believe are not, insurmountable and in many aspects and areas real progress is being made toward the solution of pollution on the farm. However, it won't be easy to move ahead at the pace necessary to meet regulatory standards and time schedules, and let us be aware now that the cost will be high.

Thanks to the vision of Tama Jim, who began much and inspired immensely the research programs while he was Secretary of Agriculture, in the land grant colleges, we have done an excellent job in increasing productivity of our land and the quality of its products. The farmers have accepted the findings and utilized the latest technological advances to optimize unit yields, while at the same time minimizing resources expended. However, there is clear evidence now that industry generally has, until

Preceding page blank

recently, neglected certain aspects and costs of waste disposal, just as has been the case with non-farm industries. There are at least two primary reasons for the neglect. Control measures demand an added investment without a commensurate financial return; and changing production practices, particularly the concentration of livestock production, have made it more difficult to dispose of wastes.

Agriculture is concerned with at least four major sources of water pollution; sediment, animal wastes, nutrient runoff from fertilizer use, and pollution from pesticides.

As most of you know, last Friday the Committee on Public Works completed extensive hearings on water pollution control legislation. These hearings have been underway for several months. In the course of them, we have heard from more than 200 witnesses from both the public and private sectors. An effort is now underway to draft comprehensive legislation which proponents believe will set the stage for cleaning up the Nation's waters.

Yet, unless we raise our sights and broaden our scope, I question whether what emerges will accomplish this objective. To me, perhaps the most striking evidence brought out at our hearings was the fact that even if the program presently contemplated is fully implemented, we will still not have cleaned up our waters. At best, the job will only be half done.

The reason for this pessimistic outlook is that we will still not have addressed ourselves to what is perhaps the most pressing source of pollution of our rivers and streams—agricultural and other non-point pollution.

This point was dramatically brought home in testimony before the Public Works Committee. Dr. Patrick Bosley, Health Office of Lyon County, Minnesota, was the witness. Through a slide presentation, Dr. Bosley described in depth the nature of the problem in his home county. Elaborating on what we are up against in attempting to deal with agricultural pollution, he said in his statement submitted for the record:

"It does not help the situation to point out that in 1966 the total human population of Lyon County was about 22,000 and the cow population was 88,000. If you use a cow-to-human conversion factor of 13 for solid waste output and 10 for liquid waste output, those cows are the equivalent of an additional human population of almost 1.5 million!"

Imagine that—1.5 million! And when you consider that Lyon County, Minnesota is but one of hundreds of counties in this country where large animal populations exist, you can begin to get a glimmering of the true scope of the feedlot pollution problem we are facing. Extrapolating conservatively on Dr. Bosley's 13 to 1 ratio, the people-equivalent animal population in this country for pollution purposes runs well into the hundreds of millions.

Moreover, animal wastes are only half of the problem. The other half relates to pesticides, fertilizers, and other nutrients transported into the rivers and streams of the Nation by means of sediment run-off. Only when these two factors are added together can we begin to realistically assess the true nature of the agricultural pollution problem we are facing.

The Congress will soon be called upon to approve a multi-billion dollar program to abate municipal and industrial pollution. Expenditure of upwards of $20 billion is contemplated over the next several years.

Concurrently, despite the magnitude of the problem, funding to abate agricultural pollution continues at a modestly inadequate rate. Only a little more than $100 million a year will be spent on watershed development projects during the same period. Yet, it is only through a vastly-expanded effort in this area that we can hope to come effectively to grips with agricultural pollution.

The Subcommittee on Conservation and Watershed Development of the Committee on Public Works, of which I am Ranking Minority Member, has begun an extensive study of this problem. In this connection, I think it is significant that Congressman William H. Harsha, Ranking Minority Member of the Public Works Committee, recommended a vast increase in funding for such a program in a recent Floor statement. Congressman Harsha declared:

"The program I envision . . . would accelerate a watershed development program designed to harness our total national water resource by minimizing and, where possible, eliminating agricultural run-off, silting and other sources of pollution."

The Harsha proposal would be funded at an annual rate of $500 million—a level of funding that, to my mind, this program needs and deserves.

Let's be clear on this: If we do not address ourselves to the agricultural pollution problem, we will very likely find that after the expenditure of billions of dollars of the taxpayers' money, and a decade of sustained effort, we will not have achieved our objectives. The rivers and streams of the Nation will remain choked with sediment, deluged with nutrients, and unfit for recreational and other uses the people would like to make of them.

To prevent this from happening, it is essential that a soundly-conceived, adequately-funded and energetically-implemented program directed at abating agricultural and other non-point source pollution be approved by the Congress. The sooner we address ourselves to formulating one, the sooner we will solve it.

GOVERNMENT TECHNICAL AND FINANCIAL ASSISTANCE

Preceding page blank

U.S.D.A. TECHNICAL AND FINANCIAL ASSISTANCE PROGRAMS

T. C. BYERLY

Coordinator
Environmental Quality Activities
U.S. Department of Agriculture

In reciting the things that the Department of Agriculture provides by way of technical assistance and financial assistance, we might as well begin with research.

There are three research agencies primarily concerned. And in our catalog of research, the Forest Service also is an entrant because the Forest Service had wide range management and forest range responsibilities. In their research on the judicious placement of water and regulation of grazing, they contribute to the avoidance of concentration of pollution on those ranges.

As far as the Agricultural Research Service is concerned, there are three divisions especially concerned. I do not wish to exclude other Divisions because the others have a role, too. The Entomology Research Division, for example, is concerned with research and control of feedlot insects.

But basically our Soil and Water Conservation Research Division is responsible for such things as air pollution and water pollution by feedlots.

Next is the engineering group. This group is constantly seeking new structures that can contain, divert or reduce pollution.

A third component, animal husbandry, looks into the possibility of recycling waste as feed. The Soil and Water Conservation Research Division is currently creating significant findings.

The next research Agency is the Cooperative State Research Service. Directly, the Cooperative State Research Service administers funds, about a million dollars worth of Federal funds, throughout the States on pollution control research. The States themselves contribute about three times that much to their own projects. Most of the States are carrying on research in this area.

To summarize the research then, we are concerned engineering wise with the containment, the diversion, the reduction of waste materials. We are concerned with utilization of that waste whether it is recycled, pyrolyed, or gasified or incinerated or composted or dehydrated, and principally, getting it back to the land where it can be used beneficially.

Another agency that is important to the research area, I should say essential, especially from a technical and financial assistance standpoint is the Economic Research Service. The Economic Research Service is responsible for evaluation of alternate methods of waste management and the evaluation of the economies of scale, organization of feedlot enterprises and for efficiency of feedlot production.

In total, the amount of research money going into this area, State and Federal, through the establishment is five or six million dollars. Now, that's agriculture money—USDA plus State. I do not have a figure for the Environmental Protection Agency.

I have called the role on the research end; let me pass then to the action end. And of the action agencies, begin with the Soil Conservation Service.

They provide the technical assistance, design of structures, design criteria. They have these organized for all the different States and Puerto Rico. The amount of local variation is very great. For example, between the eastern humid portion of the United States where evaporation does not exceed precipitation and the 17 western States where generally evaporation does exceed precipitation, the problems are quite different. I am impressed with the work that was done at Mead, Nebraska. They developed a formula, a relationship between precipitation and runoff from feedlots. As I recall, the runoff equals .531 times precipitation minus .135. That means that if you have more than an eighth of an inch of rainfall, you are going to get a runoff that will be half of the amount that fell on the feedlot. There is a reason for that. Even out in the desert feedlots stocked with at the usual rate 40 acres to ten thousand head of cattle, you are going to have about 30 inches of moisture precipitated on that feedlot, not from rain but from the cattle themselves as urine.

We can divert, we can contain, but we have no way that is feasible that we know about of telling anybody how to produce an effluent that is fit to go back into the waterways. Oh, sure, it can be done by tertiary treatment but we don't even do that with our municipal sewage. We do well if we can achieve secondary treatment let alone tertiary. So we have problems there. But from the standpoint of technical assistance whether it be holding tanks in the frigid northern portion of the country or lagoons in other areas, or holding and containment, diversion for the big feedlots. The Soil Conservation Service, through the 50 States, through the local conservation districts, has information available for all problems in this area.

I say the information is available. The demand for technical assistance in the Soil Conservation Service exceeds their capacity to respond. There may be a little lag in getting the information you want, but they have got it.

The agency that puts this information to work in cost-sharing is the Agricultural Stabilization and Conservation Service. The Agriculture Act of 1970 put more latitude in this program. They renamed and reoriented it to the Rural Environmental Assistance Program. Public interest in the environment has priority.

On the availability of cost-sharing, there are two constraints. First, the amount of money that is available is not large in this area. And second, by limitation of twenty-five hundred dollars per farm and I emphasize the word farm because these services are only available to a farm. If a feedlot is a part of a farm operation, if they grow part of the feed on the farm, o.k., that's eligible. If it's just a feedlot where nothing grows for the cattle to eat, that's not eligible as I understand it. And if it has more than a thousand cattle, it's likely to be ineligible in any case. The assistance available is very important especially on the smaller farm feedlots.

The Farmers Home Administration has no special program of financial assistance for feedlots. But those which again, are located, as in the case of the ASCS, and this is where the word family farm enters into the definition, and are a part of that farm operation, are eligible for loans. But only when there is not loan availability from other sources.

The Farmers Cooperative Service (FCS) provides technical assistance to coops. I have cited this point because this is the statutory basis for the Farmers Cooperative Service. FCS is providing technical assistance to a dozen cooperative feedlots.

Another action agency is the Agricultural Research Service. They work with State Livestock Sanitary Commissions or it's equivalent body. I said Agricultural Research Service—this is now the newly established Animal and Plant Health Service.

Finally, at last among the role of the agencies is the Extension Service. It is our information delivery system, one of the best in the United States because of its presence in every one of the counties. They have a six-State pilot project on feedlot waste management set up in the southern plains States, New Mexico, Texas, Oklahoma, Kansas, Nebraska, and Colorado. They are also sponsoring another pilot project out at Iowa State University. It has to do with the alleged odor that comes from some swine enterprises and what to do about it.

There are two other relevant portions in the Office of the Secretary. One is the Office of Information. The other is the Office of the General Counsel which keeps us all in order and participates in the drafting of regulations and that sort of thing.

PROVIDING TECHNICAL AND FINANCIAL ASSISTANCE TO FARMERS FOR ANIMAL WASTE DISPOSAL SYSTEMS

GENE L. SWACKHAMER

Farm Credit Administration

INTRODUCTION

My objective is to inform you of the experience, capabilities and limitations of the Farm Credit System in providing technical and financial assistance to farmers for animal waste disposal systems. First, I will briefly describe the cooperative Farm Credit System so that everyone understands the organization I am representing. Next, I will review some illustrative cases of financing experience by Farm Credit banks and associations and then will summarize with some observations gleaned from study of loans made to finance environmental improvement.

The Farm Credit System

The cooperative Farm Credit System is a privately owned and managed system of credit services to farmers, ranchers and their cooperatives. It is comprised of 12 Federal Land Banks and 594 Federal Land Bank Associations, 12 Federal Intermediate Credit Banks and 440 Production Credit Associations, and 13 Banks for Cooperatives. The System has a long and successful history of innovations in farm lending beginning in 1917. It has had a major role in financing the development of modern, mechanized agriculture, and it is preparing today to help finance the innovations that may be necessary to permit large-scale, concentrated livestock enterprises to exist in harmony with a clean environment.

This is a farmer-owned and farmer-oriented System. Its initial Government capitalization has been repaid by the farmer-owners who have an investment of $1.3 billion in their banks and associations. The funds used by the System are obtained from the sale of bonds and debentures to private investors through a Fiscal Agency. The System is under the regulation and supervision of the Farm Credit Administration, an independent agency.

Although the Farm Credit Banks do not make guaranteed or subsidized loans, they are Federally chartered and are known as Federally sponsored credit agencies. They pioneered the development of the agency market and contributed to the development of a viable agency secondary market. The Farm Credit Administration is responsible for approval of the terms and interest rates of securities sold to obtain funds for lending and cooperates with the Treasury to assure efficient marketing. Loans and repayments within the System are not included in the budget since they do not represent disbursements or receipts of Government funds.

During the year ended June 30, 1971 the Farm Credit System had extended $13.6 billion in credit to farmers and their cooperatives, an increase of $2.2 billion or 19.4 percent over the prior year. Loans outstanding totaled $16.1 billion, an increase of 12.5 percent from the year before and an increase of three-fold from the level of $5.2 billion in 1961. The System provided about 20 percent of farmers' credit requirements in 1970.

Some Illustrative Cases

As a System designed to extend sound credit to farmers without Government guarantee of either interest or principal, loan applications are considered on their individual characteristics such as repayment capacity, cash flow, income of the farming business, management ability, borrower net worth and the security pledged. Considerations related to animal waste disposal, the environment, and state and local laws and regulations are relatively new inputs into credit decisions for both lenders and borrowers. Experience to date with pollution control credit both within the Farm Credit System and by other private lenders indicates that both lenders and borrowers are learning by trial and error—a frequently costly process.

Because of the geographic and legal diversity of minimum requirements for animal waste disposal systems, and uncertainty as to the implications for farm credit, neither regulations nor guidelines for technical assistance and financing have yet been established in the Farm Credit System. Attitudes within the System range from the belief that "creditors have no business in telling farmers how to dispose of animal waste" to views that "banks and associations should require borrowers to provide evidence of compliance with present and potential regulations before obtaining credit." While it seems unlikely that Farm Credit Administration regulations are necessary, it also appears desirable that some guidelines be established by the banks and associations for credit decisions involving pollution control facilities.

Two conditions support this opinion. First, we are finding wide differences in the amounts of credit required to finance animal waste systems. Possibly even more significant than the range in amounts of credit is the size of capital expenditures for waste disposal systems. These intermediate and long-term expenditures tend to be larger than many other credit needs of farmers. For example, a $274,000 investment in a 1,000-sow farrowing and finishing unit in South Carolina contained a sizable amount for 3 manure lagoons. A $1,335,000 Texas feedlot required $323,255 of this amount for drainage and pollution control. An Arkansas poultry facility required recent financing of $75,000 to $100,000 to eliminate odor and the pollution of a nearby stream.

A second condition supporting the need for pollution credit guidelines is the frequency with which established and credit-worthy farmers have encountered difficulty in financing animal waste systems. Two recent cases will illustrate this point. One became a loss loan; the other is presently in bankruptcy.

A Kentucky poultry man with considerable experience and a successful business encountered problems as a nearby city expanded and incorporated part of his farm. On his farm were three large layer houses. Because of odor and other pollution problems, an injunction stopped his operation leaving his investment idle and unproductive. He purchased land further out and built three new layer houses. The burden of this new investment, in constrast to his old and established operation, placed greater stress on cash flow and earnings. The operating loan was increased over time from $20,000 to a maximum of $108,000 before the decision was made to write off the loan at a loss of $31,000. Although this is only a capsule picture of this case, it illustrates that without a change in management ability, pollution associated decisions—in this case relocation and more investment—can bring about major changes in requirements for debt servicing and financing. Both lenders and borrowers need to be alert to the problems that can arise when livestock production systems require pollution-associated changes in farming operations.

A second case involves a large northern state dairy farm, previously operated as a predominately crop farm. The Federal Land Bank and Production Credit Association financed the construction and stocking of a dairy enterprise designed ultimately to handle

1,000 cows. After approximately $1,250,000 in advances to finance construction of a very modern dairy facility and to purchase cows and supplies for about 50 percent capacity, waste management problems developed. A necessary change in construction, partly resulting from changes in waste disposal methods, resulted in an estimated cost overrun of from $120,000 to $250,000. In addition, another $100,000 to $150,000 was needed to install storage tanks and a means of disposal to keep effluent from polluting a nearby stream. Thus, what began as expansion of a farm business by a responsible and successful farm family deteriorated into a quagmire of cost overruns and hopeless debt burden primarily due to unanticipated problems with animal waste disposal.

In these cases I am sure you can see errors by both the lenders and the borrowers, as well as size-related problems not previously encountered by either. I also would hasten to add that these two cases are not typical but were selected because they illustrate obvious problems. We as lenders recognize a responsibility to provide sound credit and technical advice along with the credit. But, before lenders can advise borrowers we need additional staff training, more experience with manure disposal and utilization investments, and better information on the ability of farm businesses to absorb the costs of low-productivity investments with social benefits. Because of the obvious already large credit needs of these investments, and the prospects for more comprehensive pollution control financing in the future, some general guidelines will benefit both lenders and borrowers.

SUMMARY

In the process of reviewing loans made by Farm Credit banks and associations for waste management systems and other environmental control measures, the following conclusions were reached.

1. To date, cooperatives have experienced more problems with waste management than have individual farmers, but neither have done an especially good job of anticipating needs.
2. Relocation of facility or farm frequently occurs as the chosen method of resolving pollution problems. In some cases, the relocation merely deferred the problem to a later date. In several cases the relocation brought unexpected problems of debt management.
3. Capital expenditures for waste disposal systems have frequently led to unanticipated cost overruns, producing added stress on working capital and repayment capacity.
4. Both lenders and borrowers frequently fail adequately to review new laws, zoning regulations, water needs, longer range considerations and other pollution related issues. The oversight of any one can produce problems.
5. Many alternative methods exist for handling animal wastes, no single one being uniformly best in all cases; thus credit decisions for waste management financing frequently are made without good benchmark experience.
6. Amounts for pollution control are often intertwined with total credit requests and may not receive adequate attention as a special capital expenditure.

Even though these observations are based upon a limited sample they do seem to indicate that a period of learning and adjustment is underway. They also would appear to suggest that laws, regulations and guidelines should be sufficiently flexible so as not to force a particular method of animal waste management. Public demand for environmental protection is producing new considerations for both lenders and borrowers as they seek to reconcile social benefit-cost issues with private investment-production decisions.

TECHNICAL AND FINANCIAL ASSISTANCE FOR THE CONTROL OF ANIMAL WASTES

KENNETH M. MACKENTHUN

Acting Director, Division of Technical Support
Office of Water Programs
Environmental Protection Agency

In confined animal feeding, manure is an unavoidable product, which becomes a liability for both the operator and the public. It is a repository for diseases and pests and it is a significant and catastrophic polluter, when it or runoff from it reaches a waterway.

In 1970, there were about 184,000 feedlots with over 1,000 head from which 25 million cattle were marketed. Three hundred and fifty feedlots alone marketed nearly 9 million cattle. The daily manure production averages 60 pounds per head for each 1,000 pounds of live weight animal. An estimate of the national production of livestock manure in the United States in 2 billion tons annually.

Manure is about 85 percent water. However, a 1,000 pound animal will excrete 0.4 pound of nitrogen, 0.04 pound of phosphorus and 9.2 pounds of biochemical oxygen demand on a daily basis. On a pound-for-pound basis, the potential for phosphorus pollution to a receiving waterway from a steer and a human is comparable. Winter runoff concentrations from a cattle feedlot have reached as high as 750 mg/l phosphorus and 2,000 mg/l ammonia nitrogen. Runoff can be toxic to aquatic life, remove needed oxygen from the water, and supply food for the development of nuisance biological pests.

Appropriate management practices to control the discharge of water from feedlots include: minimizing the quantity of runoff by diversion of all water outside the feedlot, controlling runoff inside the feedlot, detaining runoff that does occur from the feedlot in ponds or lagoons, returning the detained liquid to the lands, and returning the solids to the lands.

The Environmental Protection Agency has a number of grants for research and demonstration and technical assistance activities that are applicable to the control of animal feedlot wastes.

Under Section 6(b) of the Federal Water Pollution Control Act, grants are authorized to persons for research and demonstration projects with the prime objective to develop by the late 1970's techniques for the complete elimination of point-source wastes, as well as to develop and demonstrate technology for the renovation of wastewaters for reuse. The maximum award for demonstration grants is 70 percent, but not more than $1 million. The realistic average award is more in the neighborhood of 40 to 50 percent of the project cost. No grant shall be made unless it is determined that such project shall serve a useful purpose in the development or demonstration of a new or im-

Preceding page blank

proved method of treating industrial wastes or otherwise preventing pollution of waters by industries, and that the method shall have industry-wide application. The applicant can be a State, municipality, interstate and intermunicipal agency, public and private institution, industry, or individual.

Currently there are 18 research and demonstration projects funded under Section 6(b) with a total annual budget of approximately $1.5 million. These projects address themselves to automated water pollution control systems, recirculating treatment systems, closed system waste management, soil treatment of feedlot runoff, demonstration of feasible handling and treatment processes of wastes, the characteristics and role of animal wastes in the pollution complex, and the design criteria for waste treatment systems.

In addition to the research and demonstration grants, technical assistance is available in the Office of Water Programs' Division of Technical Support and in comparable support groups within the ten regions of the Environmental Protection Agency. The objective of this program is to assist Federal, State, Interstate, or local authorities in the control or prevention of water pollution through application of existing technology beyond the limitations of their own resources. Upon the request of any State water pollution control agency, the EPA may conduct investigations and research and make surveys concerning any specific problem of water pollution with a view of recommending a solution to such problems.

The Division of Technical Support has a modest cadre of engineers and scientists devoting their talents to rural waste problems, which include the problem of animal wastes. Our immediate objective is to inventory animal feedlot operations throughout the nation and to identify and inventory the water quality problems associated with these operations. This information will be collated, analyzed and stored for subsequent retrieval and use as needed. The long-range national program is to develop cost-effective technical methods of handling, treating and/or recycling animal wastes and to establish control guidelines consistent with the newly developed technical methods. After the inventory data have been evaluated, various kinds of installations representing specific geographical areas and problems will be selected for special in-depth studies. Technical assistance in the form of consultation is available now and as information is obtained on specific problems and their solutions, this will be made available to operators, State and local water quality control agencies, and interested agencies within the Federal Government.

Training courses in the technical aspects of pollution control are given periodically at regional centers. These courses may be of a general nature for novices or highly specialized advanced courses for professional personnel. Generally they encompass a one-or two-week period. Personnel from EPA research, technical assistance, and management programs present the majority of the lectures with professional specialists presenting some lectures.

The scheduling and nature of the training courses are tailored to expressed program needs. If there is a demand, specialized courses in the control of animal wastes can be developed and presented.

The Solid Waste Disposal Act also provides grants for demonstration projects to determine the feasibility of new techniques of solid waste management and to serve as models for other communities to adopt. Federal support can be as much as two-thirds of the cost of the project including essential construction costs. Recent examples of such grants that have been addressed to animal waste problems include dairy manure management methods and dairy manure collecting and composting studies.

The Solid Waste Disposal Act provides for technical assistance in the form of consultation and investigation. Both the Solid Waste Disposal Act and the Federal Water Pollution Control Act provide grants to assist State, interstate, municipal, inter-municipal agencies and organizations in development of plans and programs leading to the solution of solid waste management problems and the control of water pollution. Both Acts also provide for grants to be awarded to public and private non-profit agencies and educational institutions to expand and improve training and education in the causes, control, and prevention of water pollution and in the management, supervision, design, operation, or maintenance of solid waste disposal or resource recovery equipment and facilities. Research training fellowships can be awarded also to increase the number of specialists needed to conduct programs relating to solid waste management or water pollution control.

A continuing exchange of information among the operator and all levels of government is essential to the development of the most economical and appropriate solutions to animal waste problems. One example where you in the operating fields can be of material aid is in connection with cost information. The cost of installation of control structures, as well as combinations of pollution prevention methods and control structures varies with the geographical region. Some of you have already installed preventive measures and control structures and have cost information available. Resumes of this information would be most useful to us in the development of recommendations and guides for the most economical and appropriate control measures for the various areas of the country.

As part of a $1 million Industrial Wastes Studies Program the EPA conducted this past year that included 20 industrial wastes categories, a comprehensive contractor-prepared report has been obtained on "Livestock Feedlots". Consultants who evaluated the Program reports and the data they contain have declared that these reports represent the greatest accumulation of information on each industrial category that has ever been assembled.

The industrial wastes reports, including the one on "Livestock Feedlots" will serve three primary functions for EPA: (1) they will assist in the evaluation of discharge permit applications pursuant to the River and Harbor Act of 1899, (2) they will provide a baseline for orienting needed research efforts, and (3) they will serve in the development of pollution control performance standards should applicable legislation be passed that is now in the Congress.

The "Livestock Feedlots" report includes a description of the industry, a summarization of the available wastewater data, and descriptions of currently available waste treatment and control. A reference guide, based on this report, is now being prepared that will list significant wastewater characteristics to be considered in evaluating effluents and effluent wastewater constituent levels that are technically achievable by most operators in the industry. The reports are now undergoing final review and editing. We hope to be in a position to distribute publicly the comprehensive report and the reference guide for "Livestock Feedlots" by the end of November.

The Environmental Protection Agency is acutely aware of, and concerned about, environmental pollution arising from confined animal feeding areas. We will do all within our jurisdictional boundaries and resource capabilities to control pollution from this source. Agency assistance in the form of consultation, research grants, demonstration grants and training are available to speed the control of this waste source. Inquiries are welcomed and the Administrator will consider appropriate requests with dispatch. Regional EPA Administrators should be contacted in their respective offices in Boston, Massachusetts; New York City; Philadelphia, Pennsylvania; Atlanta, Georgia; Chicago, Illinois; Kansas City, Missouri; Denver, Colorado; Dallas, Texas; San Francisco, California or Seattle, Washington. In Headquarters, the Administrator's address is Environmental Protection Agency, Washington, D. C. 20460.

SMALL BUSINESS ADMINISTRATION PROGRAMS TO PROVIDE FINANCIAL AND TECHNICAL ASSISTANCE TO SMALL FIRMS IN SOLVING PROBLEMS RELATIVE TO ANIMAL WASTE DISPOSAL

ARTHUR E. ARMSTRONG

Director, Special Programs
Office of Financial Assistance
Small Business Administration

It is the policy of the Small Business Administration to make, participate in, or guarantee loans to small firms for any worthy business purpose and certainly waste disposal of any kind is a worthy business purpose, particularly in these days of ecological awareness.

SBA has been cognizant for many years of the importance of environmental protection, safety and health, consumer protection, and pollution control. One of the first SBA loans I reviewed some dozen years ago was one applied for to upgrade a meat plant to permit interstate sales of the product. In 1967 or '68, our field directive was amended to specifically deny loans in certain cases unless satisfactory arrangements were made to eliminate or preclude water pollution caused by the applicant's activities or operation. Consideration was also to be given to increasing loan amounts requested to provide for acquisition and installation costs of waste disposal or waste treatment facilities with the same approach being permitted in respect to air and solid waste pollution. Needless to say, this instruction remains in effect today!

As you may or may not know, SBA is the sole federal government source of loans and guarantees designed to help small profit-making firms if financial assistance is not otherwise available to them. These loans and guaranties, under what we call the "regular" business loan program, are limited to $350,000 and to 10-15 year terms by law. Direct loans are also permitted by the law but because of fiscal restraints felt generally throughout the federal government, emphasis in recent years has been on the guaranteed and participation loan programs, both of which are limited to a 90% involvement on the part of SBA. The direct loan interest rate is set at 5½%, which is also applicable to the agency share of any participation loan. Private lenders can charge as much as 7¾% on their share of participation business loans and up to 8¾% on a guaranteed loan.

SBA presently has no special program—i.e., legislative mandate—to grant emergency finan-

Preceding page blank

cial assistance for environmental control or for improvements necessitated by the passage of state or federal pollution control laws if compliance causes economic injury to an affected small firm. Consumer protection loan authority (under meat, poultry, and egg products legislation) and health and safety lending powers for both small mines and many other businesses were given to SBA just in the past two years. What makes these programs special is the fact that 30-year terms are permitted and the loans carry no maximum amounts. If direct loans are made, there is an advantageous interest rate.

However, S-1905, which has been reported out of committee and passed by the Senate is pending in the House and if passed there, would give the agency special loan authority similar to the occupational, coal mine and consumer protection programs. Such loans, again, would be made only to those small firms suffering economic injury as a result of governmental anti-pollution action.

In reading the informational material covering this symposium, it seems, however, that the interests here are somewhat broader than animal waste disposal for disposal's sake. In other words, reprocessing or recycling of the wastes is also under consideration. Again, this is a worthy business purpose in our view. Establishing firms to reprocess or recycle wastes is not impossible for we can and do lend money to launch new business operations. It must be said, however, that R & D loans are extremely difficult for us to handle, principally because the cycle of most R & D is of longer duration than our loans! If an existing business merely wishes to purchase or install recycling or reprocessing equipment, this would be treated by us as a normal business expansion or realignment, and a justified use of loan proceeds.

Since SBA is a lending agency, it is concerned with credit criteria or requirements. As any other lender, SBA is interested in the character of its borrowers (or the management thereof) and in repayment ability. Additionally, we consider the overall management ability, capitalization, and collateral. Under present conditions, banks or private lenders investigate these aspects of a loan application with SBA reviewing them secondarily.

You will have noticed that I have referred throughout my remarks to "small" firms and you might well ask what "small" means. At SBA, for lending purposes, a small retail or service concern is one whose sales, generally, do not exceed $1 million annually. A small wholesaler is one which, again in general, generates sales of $5 million or less. The size of a manufacturing concern is based upon the number of employees which can range from any less than 250 to less than 1,500, depending upon the industry.

My comments so far have been limited to the business loan program but we also have development company loan programs, a lease guarantee program, and possibly others that could be useful in animal waste disposal activities.

It should be remembered that SBA is not empowered to make any type loan or guarantee to agricultural enterprises, being limited in its activities to commercial operations. Small firms performing services for agricultural endeavors are, of course, eligible for our assistance.

Management assistance (through SCORE and ACE) and technical assistance (via our technology utilization program) are also available in our 77 field offices and could well be helpful to small operators in solving their disposal problems.

FINANCIAL ASSISTANCE FOR THE CONSTRUCTION AND IMPROVEMENT OF IRRIGATION SYSTEMS

J. C. YATES

Water Resources Specialist
New Mexico State Government

INTRODUCTION

Since the turn of the century, the Territorial and State legislatures have appropriated funds for programs relating to water supplies for irrigation and projects for the construction and improvement of irrigation systems. Funds appropriated are from a trust fund account which derives its income from grants of land made by the Congress of the United States in 1898 to the Territory of New Mexico. That Act of Congress (30 Stat. 484), commonly referred to as the Ferguson Act, granted to the Territory some 500,000 acres of land. The income from this land may be used ". . . for the establishment of permanent water reservoirs for irrigation purposes." Under interpretations of our courts, activities which benefit irrigation are permissible.

For many years, the State legislature has favored improvements to community ditch systems, first by appropriations made for named ditch organizations in certain counties, and since 1965, a single appropriation annually for any system in the State. Recent appropriation acts state the purpose as ". . . for constructing, improving, repairing and protecting from floods the dams, reservoirs, ditches, flumes and appurtenances within the State" and with the provision that not more than $10,000 shall be spent on the works of any one community ditch and, further, that not more than 15 percent of the total cost of any one project shall be paid out of the appropriation.

The Community Ditch

The community ditch is an institution peculiar to the native people living in that portion of the southwest which was acquired by the United States from Mexico. It was a part of their system of agriculture and community life long before American occupation. After the Territory of New Mexico was organized the legislature provided for the government of community ditches and incorporated into the written law of the Territory the customs theretofore governing such ditches. In the irrigation laws of New Mexico the practices and customs of community ditches have been jealously safeguarded.

Prior to 1964, construction and improvement were engineered and supervised by State Engineer personnel. The office usually provided all materials, equipment and skilled labor. The ditch associations usually furnished common labor. Because many of the earlier appropriation acts provided that we could not spend more than $10,000 on any single ditch system, it was not possible to finance many permanent-type structures, although previous construction was improved to better withstand damage or destruction by unusual floods. The cost of engineering and administering this work was high, particularly when local common labor was furnished by the ditch associations.

We looked at the programs of the U.S. Department of Agriculture, particularly the Agricultural Conservation Program under the Agricultural Stabilization and Conservation Service. Under that program a conservation need that could best be solved by a group of irrigators pooling their resources was offered grant funds and technical assistance.

Cooperative Program Developed

Under State coordination in the autumn of 1963, a cooperative program was worked out with the Agricultural Stabilization and Conservation Service, the Soil Conservation Service and ditch organizations. As part of its regular program, and without expense to the ditch organizations or to the State, the Soil Conservation Service agreed to contribute engineering services, to supervise construction, and to approve the completed projects. When a project had been constructed and the Soil Conservation Service had certified that all work had been completed in accordance with plans and specifications, the ASCS and the State Engineer reimburse the ditch organization in the amounts of their agreed participation. The acceptable ACP practices under the cooperative program are reorganization or irrigation systems and lining irrigation ditches. Initially, ASCS paid to the participating groups 50 percent of the construction costs, later to be extended to 70 percent cost share in a few counties, then to 70 percent in all counties of the State. The State and the ditch organizations agreed to share equally those construction costs not paid for by the ASCS. The first project under this cooperative program was undertaken in December, 1963.

After the program was developed, the State discontinued the force account and contract work on ditches and took the position that thereafter State funds appropriated to the State Engineer for dam and ditch work would only be used to match ditch organization funds on projects constructed under the Agricultural Conservation Program. State officials work closely with the Soil Conservation Service and the ASCS in promoting such projects. The State gives technical assistance to the SCS in planning projects. State officials, together with the county ACP managers, assist the ditch organizations in preparing their applications.

The Four Corners Regional Commission

The Four Corners Regional Commission, authorized by the Public Works and Economic Development Act of 1965 (P.L. 89-136, as amended) administers an economic development region covering more than two-thirds of the states of New Mexico, Colorado, Utah and Arizona, and comprising an area larger than Appalachia's 13-state area. That Commission has made funds available to the cooperative program in several instances when ACP funds were inadequate to provide the regular 70 percent contribution. This has assured initiation of some projects which otherwise could not have been financed by the ditches.

A great boost in the success of the program was the determination that the Interstate Stream Commission could loan qualifying ditches their share of construction costs at a low rate of interest (2½%) with repayment scheduled for periods of up to 20 years. Again, these funds derived from the same trust fund from which grants are made. Thus far, about $250,000 has been loaned.

A principal advantage of the cooperative program is that State funds will go many times further in improving ditches for the conservation of water than would have been possible if the State went it alone. More important, it provides an incentive for a group of irrigators to work together to affect the solution of a real conservation need that is within their ability to finance. The attitude of the ditch people has changed. They no longer say: "Come and fix our ditch; the legislature appropriated money to the State Engineer to fix it." Now, they say: "With SCS help we have developed a plan to fix our ditch. We can finance our share of construction costs out of our pockets or with borrowed money provided the State contributes 15 percent. Will you help us?"

The progress of the program can be illustrated by the following: In fiscal year 1961, the State spent $42,330 for perhaps $55,000 worth of improvements including administration and engineering costs by the State Engineer, and unskilled labor contributed by the ditches. In fiscal year 1965, the first full year of the cooperative program, the State contributed $9,700 which resulted in about $65,000 spent on ditch improvements exclusive of engineering costs by the SCS. In fiscal year 1971, the State's contribution amounted to $88,000, resulting in about $600,000 spent for ditch improvement. So far, in this fiscal year, the State has obligated contributions amounting to $57,000 on 21 ditch projects. Since the State began in 1963 to cost share with community ditches in the Agricultural Conservation Program, the State has spent about $465,000 for total project construction costs of about $3.2 million exclusive of engineering costs by the SCS.

SUMMARY

The accomplishments have been significant. Work has been completed or is under way on 165 ditches in nearly all of the counties where community ditches are located. Work includes installation of concrete ditch lining, plastic and concrete pipelines and appurtenances for the distribution of water; works for flood protection of irrigation structures; construction of diversion dams, ditch headings and sluiceways; and improvement of impoundment dams. In most instances, the installation of these works provides assurance of a better water supply to the farmer and, I think in all instances, encourages efficient conservation of water by improving farming practices to realize a greater farm income.

The Soil Conservation Service, Agricultural Stabilization and Conservation Service and the State Engineer encourage the construction of one diversion dam to serve several ditches previously diverting from individual headings. When the ditches continue their status as individual entities but agree to cooperatively operate a single diversion, the State can cost share up to $10,000 per ditch. In many instances, only by consolidation is it possible to construct a permanent-type diversion economical to the parties who must finance its construction. Two-, three-, four-, and five-ditch diversions have been constructed. Being actively encouraged are a seven-, a nine-, and a twelve-ditch consolidated diversion.

In addition to grants and loans to community ditches, the Interstate Stream Commission has loaned to irrigation and conservation districts about $1.8 million which they, in turn, lend to farmers to participate individually in the Agricultural Conservation Program for lining ditches, leveling land and undertaking similar conservation practices.

The cooperative ASCS-SCS-Ditch-State program is working well in New Mexico. The State legislature is providing appropriations sufficient to accept all requests from ditch organizations for State contributions of 15 percent for construction costs. New Mexico is fortunate in having a trust fund account which provides monies for conservation practices on irrigation systems. Although the same trust fund probably cannot be used in New Mexico for solution of animal waste management purposes, the success of the cooperative irrigation systems improvement program may encourage others to seek acceptable Federal-State-Local programs for animal waste management.

DISCUSSION: GOVERNMENT TECHNICAL AND FINANCIAL ASSISTANCE PROGRAMS

FROM THE FLOOR: Mr. Murray, I'd like to direct a question in general. Throughout this conference we spread out the broad picture of the type of pollution from agricultural animal waste. And we have cited specific cases and I'm sure if we get down to individual cases here, and this panel directed its comments to financial assistance programs. I'd like to say that I'm sure that many animal feedlots, dairy, cattle operations, and poultry operations that are financed in their present financial situation, their loan load is adjusted to be accommodated by their income. Now they are faced with a situation either voluntarily or by force, they are required to spend a large amount of money to handle in a different way the animal waste from that operation. It may not be economically feasible for them to do it under their present loan situation. And yet there are funds available other than the sources they now have. I can visualize a man who cannot go to his bank to borrow money because the bank understands the income potential and yet maybe forced to go to one of the agencies here on a share-cost basis. That will put him in a financial situation that will unbalance his ability to pay and put him out of business. Mr. Slotmire gave a couple of demonstrations that show it's repeated right across this country. I don't think this is a good situation. And individually it's a tragedy, even if they can pay it back, if they remove the possibility of various things, like a man educates his children, sends them to college and so on and so forth. On the fact that it is dictated to my belief in many cases, to the forceful impact on the people of his community or the Nation at large. I believe that this is a serious situation that particularly when we get to the financial end of it.

I'd like to address this question to the panel. These are still loans we are talking about, and I have not heard any of the cost-sharing that was indicated yesterday which could be passed on to the consumer. I don't believe that there is a single producer of beef, dairy or poultry that believes this to be the case.

MR. HYDE MURRAY: I'd like to nominate Dr. Swackhamer to be the panel member to take on this answer. I think you have raised a serious list of issues there about the practical side of financial assistance.

DR. GENE SWACKHAMER: One of the objectives of my presentation was to make a modest appeal for economic consideration because of the things that appear to be developing as we finance. We see that we are first financing a total package of which only one part might be animal waste management. But associated with that, quite often, is the decision to enlarge the operation. Because if you are going to put in a waste control system, you are probably not going to put it in for existing capacity. You want to plan ahead; you want to think into the future. That's where I think quite often it

Preceding page blank

puts additional financial stress on the business, because maybe a five hundred head feedlot expands to nine hundred. That brings associated problems. Do you need additional storage? Do you need milling capacity? There are many other things that are associated with the animal waste financing, but relate to the total operation itself. The ability of any given operation to carry the added cost of investment, which I think this would have to be categorized as,—investment either intermediate or long term—very much depends on its economic viability and that is the criteria that I think almost all private lenders would have to look at. And hopefully, we will develop from the experience of what we are now doing to give better counsel to all potential borrowers who are faced with some problem of waste management.

At the present time, our lending experience indicates a wide array of attempts and efforts not all of which are successful. Even the relocation which may appear to be the simplest solution, quite often leads to additional problems of a financial burden, because the farmer may be going from some existing system that is established into something new and different. I think as an economist, my conclusion would be—either in animal waste disposal or in some associated field—don't lead someone into a situation without taking into consideration the total economic relationship of the production system. Because that is what is going to have to pay out the investment over the long run.

I think we'll make errors. We are in our lending system, I'm sure others are too, but our criteria for analysis of a given credit case will have to depend upon it's ability in the long run to carry the new investment.

I don't think that animal waste financing need necessarily be a nonproductive sort of investment. It may be predominantly because of the social benefits which do not accrue to the producer himself, but accrue to the people that will no longer smell the pit or something like that. And that perhaps is a burden. But I can see that there could be increased improvement in operating efficiency and in the maintenance of livestock. So it need not be a nonproductive investment, but there is very definitely the social aspect which is a burden in a private production systems, particularly for modest scale operations.

MR. HYDE MURRAY: I would like to hope to ask Dr. Byerly to adjudicate that response.

DR. T. C. BYERLY: I think the question that has been raised is a very important one. I want to emphasize two things. First, I refer to the Rural Environmental Assistance Program, the major purpose of which is to improve the quality of life for all people. This will be accomplished by helping farmers and ranchers to prevent or abate agricultural relating pollution in water by conserving agricultural soil, water, wood lands and wildlife resources. Here, by substitute, the principal of public interest, public participation and cost is established. The funds and the availability of those funds is very limited. Let me also comment, I'm looking at Elmer Davis from the standpoint of where the cost finally falls. I believe in the measures taken to correct pollution, the cost finally falls on all of us either through the price at market place of the animal products we buy or through taxes. Would you agree?

MR. ELMER DAVIS: I think you raised a good point. The problem with most agricultural producers is passing this on to the price. And that is why when you talk about cost-sharing you essentially, as consumers we are paying for this through our taxes. So this is one element.

You can also have different tax rightoffs. There are ways, it's extremely difficult in agriculture, as we think about all of our environmental questions, it's slightly different when you are talking about animal waste or pesticides, but the problem of how you—who pays for this, how does society pay for it. And I think these are the questions that need to be faced with this problem at this seminar.

FROM THE FLOOR: I'd like to make some comments with regard to the problem situation. I was wondering here in terms of new installations or expansions, I was wondering whether you had some guidelines or rules of thumb in terms of expenditures, say, in thinking in terms of the percent of the investment made. Maybe Dr. Swackhamer could comment on this.

DR. GENE SWACKHAMER: A short answer is "no." I don't have, neither does the Farm Credit Administration, nor to my knowledge does any of our 12 regional banks—either in the short-term or long-term real estate credit—have any guidelines that they follow. Now, perhaps individuals who are involved in credit analysis or decision making and business credit might have some rules of thumb, but I think because of the wide diversity in alternative methods of animal waste disposal we have got a wide array of guidelines and rules. I don't think we can say for a given lagoon system or a given pit of some kind that there is an optimum set of guidelines.

FROM THE FLOOR: I thought that here was in terms of say, a poultry producer that he might go in for a given percentage of his investment.

DR. GENE SWACKHAMER: Just for animal waste?

FROM THE FLOOR: For animal waste. For example, going back to—depreciation, interest, repairs, something along this line?

DR. GENE SWACKHAMER: Not to my knowledge do we have any kind of guidelines that are at all reliable. In my prior position with the Federal Reserve in Kansas City I visited almost all of the large cattle feedlots in that tenth Federal Reserve District trying to find what the costs of capital expenditure was to a facility. And there the range was phenomenal. Out in the panhandle area of Oklahoma and the feedlots in those counties, the operations are very similar but the investments ranged quite widely. I think even in a normal investment you are going to find a wide range. We don't have any fixed criteria for what percent of the total capitalization could be absorbed for animal waste. I think it depends so much on the operating business itself and its product.

MR. HYDE MURRAY: I think we'll have time for two more questions.

FROM THE FLOOR: I would like to ask Dr. Swackhamer, do you find that you take this credit analysis and a credit decision as to whether you are going to make the loan. And assuming that you do have the evidence at hand that the proposed animal waste system meets the demands at that time of the federal and state agency that the very uncertainty that two weeks after you make this commitment, he has got in the installation, you got your investment, and so has he. Someone comes along and notwithstanding somebody having said, this was acceptable, that's off the board, you have got to go through the whole system again. Do you find this a question in credit analysis?

DR. GENE SWACKHAMER: I think because all of our credit decisions are predominantly made at the local level unless they are exceptionally large loans which require some degree of prior approval, that the capability of the individual manager of a production credit association or land bank association or of the credit man in the district bank, is the factor which will determine how extensively they anticipate or check the existing regulations, zoning ordinances and other things. I think our experience indicates that because these are new factors in the credit decision, they have not been accustomed to checking thoroughly all of those sort of things.

I think some guidelines are perhaps needed, saying that at a very minimum, you check some of these things automatically on any minimum investment. Some of the problems that have been encountered have obviously been encountered because of the inability of either the lender or the borrower to anticipate expansion in a very short period of time of a residential community or rezoning or a change in some kind of a water regulation or control. And that is a part of the trial and error experience we are going through.

There is need for additional training in this area because it's new to many other lenders too. But your point has been well taken, there has been a lack of foresight in many cases, perhaps understandably so because of the newness of pollution credit.

MR. HYDE MURRAY: Time for one more question?

FROM THE FLOOR: I was under the impresion that SBA does not loan to farmers. I get the impression that maybe they can and I wanted some clarification?

MR. ARTHUR ARMSTRONG: We cannot lend to farmers, but we can lend to for instance, commercial feedlots. A commercial feedlot, if it is deemed commercial by the Agriculture Department and beyond them then we can help.

FROM THE FLOOR: How about in special areas?

MR. ARTHUR ARMSTRONG: Not into anything but the production of food and fiber. Now, we consider a feedlot as a service operation.

MR. HYDE MURRAY: One more brief question?

FROM THE FLOOR: I would like to pose one and most of this has been discussed on the removal of animal waste, but no emphasis has been put on the odor. And this is becoming more of a problem in terms of air pollution than it is water because there are no quantitative measures. I represent the turkey industry at this meeting today and we have been classified by the Environmental Protection Agency as a feedlot in raising our turkeys. Now, most of the people have had to incorporate on various farms to get the finances necessary to conduct their businesses because of the homestead laws and other things that the common lender will not consider. Now the FHA won't assist us because we are solvent. The SCS, the ASCS won't do it because we don't produce the feed on the farm to feed our turkey,—in Texas has said that we are an agricultural enterprise and they won't touch us. So where do people go to get this money to improve this environment for the people other than ourselves.

A public utility, you know, they had to spend 50 million dollars, they immediately get a rate increase and this takes care of their expenditures. Plus the fact that if they need three thousand acres of zoning land they can condemn this land and take it. But if we need the adjoining land to put reservoirs, it's too bad, we can't condemn it, the neighbors won't sell it. So, you people who represent the policy making agencies that are going to be looking at us and us at you. I would like an answer.

MR. HYDE MURRAY: There was once a divinity student who was studying theology, he came across a chapter on sin, and he siad, "you know, studying about sin in divinity school, I really ought to get down to the real thing and find a little bit about it, more than the abstract side of it." That evening he went down to a local tavern and proceeded to drink extensive amounts of alcohol. And then he staggered out of the tavern and he slipped and fell in an area which had just been poured with recent cement. In the morning he woke up and he was frozen solid in this cement. And the workmen came in, in the morning and found this divinity student in this hardened cement, and they got the air hammer out and they chiseled him out and he staggered back to his dormitory at the seminary. And one of his friends said, "well, what did you find out about sin?" And he said, "well, I guess it's all right in the abstract but it sure is hell in the concrete."

TELLING THE STORY

THE LAKE MENDOTA WATERSHED PROJECT

DONALD G. LAST

Environmental Quality Agent
Dane County — University Extension
The University of Wisconsin

INTRODUCTION

Setting and Problem.

Dane County, in the heart of the southern Wisconsin dairyland, as a result of its glacial heritage, is richly blessed with natural lakes. The largest of the lakes is Mendota. Lake Mendota together with its smaller twin, Lake Monona, provides a strikingly beautiful setting for the Madison metropolitan area and the University of Wisconsin campus as viewed from the air. The lake, however, is not without problems.

While all lakes naturally "age", since the advent of a white settlement in the county, and especially during the last few decades, Lake Mendota has been aging at an accelerated rate. Once, the clear, oxygen-rich waters teemed with cool water fish. Today, the water is warmer, over-nutrified (eutrophic) and choked with algae and rooted aquatic plants. Oxygen levels have been reduced so as to support only more tolerant fish species. No longer is the lake ideal for human enjoyment.

The growth of human and livestock populations has caused increasing pressure on this water resource. The activity of man within the watershed, both on the farm and in the city, has led to an unprecedented inflow of both sediment and nutrients. This enriched diet of sediment and nutrients has literally made the lake sick!

Project Objectives.

The urban community has made several attempts to reduce the flow of its pollutants into the lake. However, until recently there was no comprehensive program within the 241 square mile Lake Mendota Watershed to curb the inflow of both sediment and nutrients from agricultural lands.

The Lake Mendota Project was conceived and initiated to provide approximately 900 farm owners and operators with an opportunity to improve Lake Mendota. It has been designed (1) to stimulate greater use of traditional soil conservation practices; (2) to promote better management of barnyard and feedlot runoff; and (3) to encourage construction of farm animal wastes storage structures so as to reduce manure loss in runoff from frozen fields. The element of the project which has attracted the greatest amount of attention is a special provision for cost-sharing on the construction of facilities for the winter storage of farm animal wastes.

Birth of the Lake Mendota Project

A report[1] prepared in 1966 by a group of University of Wisconsin and State of Wisconsin

---

[1] *Report on the Nutrient Sources of Lake Mendota*, Lake Mendota Problems Committee, 1966.

Preceding page blank

scientists presented data on the sources of nitrogen and phosphorus entering Lake Mendota. It was estimated that 30% of the phosphorus which entered the lake stemmed from runoff from agricultural land on which manure had been spread. Potential for this type of runoff was found to be particularly high during the winter when snow cover or frost made the soil impermeable.

Subsequently, in the fall of 1968, a thirty man Dane County Water and Related Land Resources Technical Panel was created which had as its goal to "suggest answers to problems involving Dane County's water resources". Among the many positive lake improvement recommendations of this report was one which called for greater "adoption by private land owners of conservation practices that reduce siltation and *recommend use of methods for handling animal wastes that decrease water pollution*".

This recommendation encouraged local agriculture representatives to suggest the development of an ASCS funded manure storage pilot practice for the Mendota watershed. The request for such a cost-sharing practice was favorably received in Washington. Beginning on May 4, 1970 farmers qualified for up to $2500 to be used on "livestock farms in the Lake Mendota watershed where a storage facility for barnyard manure is needed as an integral part of an orderly manure disposal system to reduce water pollution."

Organizational Framework

This project is a cooperative venture involving many people from several agencies. The ASCS is responsible for administrative and financial assistance. The SCS provides technical guidance in the design of structures. The local University of Wisconsin Extension office handles the infomational and educational segments of the program. Auxiliary agencies involved with the project include the Wisconsin Department of Natural Resources and the state and local milk marketing and regulatory agencies.

A great deal of time was profitably spent "behind the scenes" in an attempt to make the project truly a cooperative one. Agency roles and responsibilities had to be sorted out, priorities established, procedures developed, and personnel assigned. The next major step was to carry the program from the *paper* stage to the *people* stage.

Implementation

Education Phase.

Overlapping somewhat the organizational period in the time continuum was the implementation period. Phase one of the implementation period was educational in nature. Great efforts were made to explain the new program to watershed residents and to inform them as to the reasons for it, and the benefits of participation.

In May, 1970 letters went out to farmers and landowners in the watershed inviting them to attend one of three informational meetings. Approximately 180 interested people attended these initial meetings at which the key elements of the program were explained.

All during the 1970 project year the newspapers carried stories on the project. Radio and TV were used to publicize the project. Also, a bi-monthly LAKE MENDOTA WATERSHED NEWSLETTER was mailed to each farmer and landowner. The word spread quickly and interest soared. Gradually the educational phase was superceded by the action phase.

Action Phase.

Once the rural community was sufficiently motivated, the resultant applications for manure storage structures were processed as outlined in the steps below.

Step 1: *Application*

This is the simplest yet the most important of the steps. The machinery is set in motion when the livestock farm owner whose property is within the boundaries of the watershed visits the county ASCS office to sign the manure storage practice application form.

Step 2: *Need Determination and Site Selection*

Shortly after an application is completed, agency representatives visit the farm to evaluate the needs for a storage facility and to select a suitable site for the unit. A facility is judged to be needed if there is any possibility of water contamination resulting from the loss of manure spread on frozen ground. A site is selected which is convenient to the user and which conforms with established regulations and guidelines. A preliminary design sketch showing the proposed facility in relation to the existing buildings is prepared for the farmer. Some alternatives with respect to construction materials and handling equipment are suggested at this time.

Step 3: *Plan Design and Drafting*

When an applicant indicates that he is ready to proceed, additional farm visits are made. More specific information on size and location of existing buildings, slope and soil, and the number and kinds of livestock is collected. The livestock inventory is used to determine as accurately as possible the size (volume) of the storage unit for the period during the year when it will be used. A final decision is made concerning the design of the facility to be built. The draftsman converts this information into formal plans.

Step. 4: *Plan Approval*

Finished plans are submitted to the County development group which decides whether or not to authorize cost-sharing funds for the project. Structural features of the storage unit are evaluated to make certain that they conform with the standards of the cooperating agencies and the provisions of the pilot program for the watershed. In part, approval depends on the status of the farm conservation plan. Construction cannot begin until assurance is received from the applicant that any SCS prescribed land treatment measures will be completed.

Applicant plans are also filed with the Wisconsin Department of Natural Resources. For dairy operations, the applicant must also obtain permission from the milk marketing regulatory agency.

Step 5: *Construction*

After a plan is approved, the construction of the facility becomes the responsibility of the applicant. He may do the work himself or hire a contractor. SCS technicians provide construction guidance and supervision, such as for leveling, staking, and engineering any diversion, collection channels, or detention ponds.

Step 6: *Performance Certification*

The SCS compares the plan with the completed structure and notes any variations. The engineering staff evaluates any changes. If they are acceptable, the SCS certifies to the ASCS that the unit has been properly completed.

Step 7: *Payment*

This certification and a review of detailed information on construction costs allows the ASCS to issue the cost-sharing payment to the applicant. The maximum allowable payment is $2500 (or 80% of cost if the total is less than $3150).

RESULTS

The initial response to the program was even greater than anticipated. Interest increased all during the 1970 project year. From June through December of 1970, twenty-seven applications for cost-sharing on animal waste storage structures were received by the Dane County ASCS office.

By the close of the 1970 project year, structures were completed on seven farms. Of the seven completed one is a liquid manure unit, and the other six are solid manure stacking platforms.

The single liquid manure unit is an open front hog finishing house with slotted floor, liquid manure pit underneath. The plan is based on a design prepared by the Engineering Dept. of Kent Feeds, Inc. of Muscatine, Iowa. The pit itself is 132′ x 10½′ x 6½′ or about 9000 feet of capacity. The owner expects this to be sufficient for 180 days of storage for 300 feeder pigs (average weight 100 lbs.).

The design of the six stacking structures are related to the facility of the University of Wisconsin Experimental Farm at Ashland, Wisconsin as well as the Patz Company of Pound, Wisconsin.

Summarized below are the *average* characteristics of these units:

(1) to provide 180 days of storage for solid manure, urine, and bedding.

(2) to accommodate a Holstein dairy herd made up of 60 milk cows (milking and dry), 30 heifers (10 months to freshen-

ing), 15 calves (1½ to 10 months), and 15 calves (birth to 1½ months).

(2) dimensions: 69′ x 53′ x 8′; average capacity 29,500 feet.

(4) total costs for earth moving, labor, and materials: $4870.

(5) five inch concrete floor over gravel base with treated post and matching plank walls.

Only one of the six stacking operators has special handling equipment. This is a true "push-button" animal waste system which effectively utilizes a manure blower at the end of the barn cleaner to directly fill the structure. All except one of the stacking structures is located adjacent to the livestock buildings to make filling convenient. Urine either may be contained with the solid manure and bedding or drained out via a paved collection channel to a detention pond which can also be designed to handle the runoff from the barnyard or feedlot.

Housekeeping or management is as important for a farmer who has a structure as for a farmer who does not. Filling should be done on a daily basis at the time the barn or yards are cleaned. Dairy animals must be fenced out of the structure at all times and the structure should be emptied as soon as possible in the spring to reduce odor and fly breeding problems. Manure storage to abate water pollution can be accomplished without increasing sanitation problems.

The motives for participating in the program are many. All of the applicants are obviously concerned about the quality of Dane County waters. The monetary incentives of the program provided the additional stimulus. Others are convinced that the savings in time, effort and money will be more than compensated in a short period of time by utilizing such structures.

PROBLEMS

A program of the scope of the Lake Mendota Project naturally presents some problems which in most cases have been satisfactorily resolved. Because the project was essentially unprecedented, great effort had to be invested to clarify objectives, priorities and procedures, and roles of the project's cooperating agencies. A complementary problem to that of agency organization was personnel. The field of animal waste management is so new that capable technical personnel were in short supply.

Another difficulty was the time element. The funds were allocated in May and the program was introduced to the masses in June. This left only six months before the weather precluded construction. Considering this time span, progress was indeed remarkable.

Finally—there was the promotional problem. For the last generation farmer's had been advised by the same agencies (including the health authorities) that the best method of managing manure was to spread it on the fields the year round. Traditional attitudes and habits are not easily changed.

IMPACT AND IMPORTANCE

The Lake Mendota project has enjoyed not only local interest and participation, but has even achieved a measure of state and national attention. It served as an important step toward finding solutions to the dilemma of providing a quantity of food for the nation while at the same time taking all due precautions to insure the quality of the environment. It has been demonstrated that this can be done on a *voluntary* basis without the need for extensive regulation, and that, with proper incentives, farmers can and will reduce agri-pollutants.

Without a doubt, the Lake Mendota Project has played a role in the transition of the Agricultural Conservation Program into the new Rural Environmental Assistance Program. The name of the new program itself suggests a subtle shift in emphasis in this cost-sharing program to a greater emphasis on pollution abatement practices. While retaining traditional soil erosion prevention practices, which in themselves abate pollution, farmland nutrient control has received a greater share of the attention than in the past. Significant is the stated goal of the new Rural Environmental Assistance Program: "To improve the quality of life for all people by *preventing or abating environmental pollution*; providing the maximum public benefit; and conserving the land and related natural resources."

The successes and failures of the past year have provided valuable lessons. The experiences gained have been applied to facilitate the orderly and efficient expansion of similar programs to other watersheds around the state and nation.

The 1970 Lake Mendota Project provided a glimpse into the future to the day when it will be environmentally expedient, economically feasible, and legally required that the problem of farm animal waste handling and disposal be overcome.

THE ROLE OF EXTENSION IN POLLUTION ABATEMENT IN VIRGINIA

DR. R. LEWIS WESLEY

Extension Specialist, Processing
Virginia Polytechnic Institute & State University
Blacksburg, Virginia 24061

INTRODUCTION

Cooperative Extension Service at VPI & SU has been, and still is, quite heavily involved in assisting the poultry industry in Virginia with pollution abatement. Extension specialists from departments in the College of Agriculture, as well as the Department of Civil Engineering, have cooperatively provided assistance to all phases of the industry. In addition, representatives of Cooperative Extension Service have continuously provided liaison between the State Water Control Board, the regulatory agency in Virginia, and the poultry industry.

Specifically, the following areas of assistance have received top priority during the past several years.

1. The design, construction, and operation of a waste disposal system for a farm and processing plant in Tidewater, Virginia.
2. Assisting with the design, construction, and operation of a waste disposal system for a rendering plant in upper Shenandoah Valley of Virginia.
3. The design and installation of a central waste water analysis laboratory in the Shenandoah Valley of Virginia. This work also included the training of necessary technicians.
4. Assisting with design, construction, and operation of a waste disposal system for a processor in lower Shenandoah Valley of Virginia.
5. The conduction of two on-campus short courses at VPI & SU on pollution abatement.
6. The design, construction, and operation of a waste disposal system for a processor in the Blue Ridge Mountains of Virginia.

A typical case history of the last example given above is attached.

Case History: The Use of Oxidation Ponds for Poultry Processing Waste Disposal

Poultry processing waste is a suitable substrate for biological degradation by both aerobic and anaerobic bacteria. The effluent from poultry processing plants contains the proper bacterial flora so that when subjected to adequate liquid-solid separation procedures, nearly complete (80 to 95% and even higher) Biochemical Oxygen Demand (BOD) removal can be achieved with the use of a series of oxidation ponds or lagoons. A grease and grit trap,

Preceding page blank

an anaerobic digestor, an aerobic polishing lagoon, and/or a mechanical aerator are the necessary ingredients for reliable disposal. In addition, final effluent chlorination is sometimes required, depending on whether or not human sewage is also involved.

A Virginia poultry processor came under court order in 1967 to either provide treatment for his 100,000 gallon-per-day effluent or cease operation. This plant is a typical Virginia operation that employs approximately 300 workers full time, and for the sake of being average, they do about $9.2 million business annually (this figure is used to show an average—does not mean that the plant being described is necessarily *average*). This plant started as a "hole-in-the-wall" operation just after the close of World War II. Prior to 1964, plant effluent was dumped nearly untreated into a "dry weather ditch," which ran helter-skelter to a receiving stream some 8900 feet from the plant. In 1964, some secondary treatment was installed at the plant. A single lagoon, four feet deep and with a surface of 60 x 800 feet—about 1-1/5 acres—provided excellent BOD removal until it became overloaded and turned anaerobic in spite of a 25 hp aerator with 18 diffuser hoods. Though the diffusers were installed in an effort to aid bacterial decomposition, in reality they added to both air and stream pollution.

Cooperative Extension Service at Virginia Polytechnic Institute and State University was contacted by the plant owner and asked for help to develop a waste system that would meet the requirements set forth by the State Water Control Board (SWCB), the regulatory agency in Virginia for pollution abatement in state waters. A committee was appointed by the dean which consisted of one extension poultry specialist (chairman), one bacteriologist, two agricultural engineers, two sanitary engineers, one soils specialist, and the director of pollution abatement of the SWCB.

The SWCB staff opened their complete files to the committee to enable them to see the various monitoring efforts that had been conducted over the years and to determine where each processing plant stood with regard to pollution violations. The committee also went about making their own measurements of: (1) water usage, (2) pounds of BODdischarged each day, (3) most probable numbers (MPN) of bacterial load at each level of sewage treatment, and (4) the total quality of sewage at the point of entrance into the receiving stream. All this was done to verify the records of the SWCB staff and to make sure that the data collected agreed with the SWCB data. This approach is strongly recommended to any work being done on pollution abatement. In this way the confidence of both the poultry processors and the SWCB staff can be attained.

Two tours of poultry plants having successful sewage treatment lagoon systems in operation (in Delaware and Virginia) were made via University aircraft and work was soon begun on the designs that would be suitable for use at any of the plants in Virginia needing assistance. After a suitable design had been agreed on by the committee, an open hearing was scheduled in the offices of SWCB where citizens could review what was being planned. The plans were approved by the staff of the SWCB.

The committee recommended that the plant management purchase 4,000 feet of pipe and some 37 acres of land on which to build the new lagoon system and that construction be started. The committee did considerable research on the proposed land to assure that the proper soil was available for lagoon construction and that no major rock outcroppings would be encountered. The committee worked closely with the contractor to insure that proper cores were installed on all sides of the lagoons and to insure proper consistency of the core to keep the lagoon from leaking. In three months the system was completed.

The initial part of the system consists of a grease and grit trap that has a total capacity of 105,000 gallons and is approximately 12 feet deep at the center. It removes 80 to 90 percent of the gross solids that cannot be screened out back at the plant. The effluent taken from about 18 inches below the surface of the pit is allowed to flow by gravity to the first lagoon. In this way, the solids that have flocculated to the top of the material remain in the pit.

The first lagoon, which is usually the largest, has a total volume in excess of 8 million gallons (15 feet deep and a surface of more than 2 acres). A two-cell effect was provided by a cypress baffle that splits the lagoon into two separate units. During the construction of this large section, a sealing material, super pyrophosphate, was disced into the entire inside surface and equally mixed with about 18 inches of selected clay material. The selected material was approximately 40 to 50 percent clay and was located just a short distance from the lagoon site.

The second lagoon is approximately 39 inches deep, has about 2 acres of surface and accommodates more than 4 million gallons. To aid in keeping this lagoon aerobic, a splashway was designed to move the effluent from one cell to the next. The waste material drops several feet onto large boulders placed into the second lagoon for the purpose of re-introducing oxygen used by bacterial decomposition of the solids.

After the effluent leaves cell number 3 it is passed through three small holding vats which discharge onto additional splash sites designed to add back the necessary oxygen. These three holding vats provide 10,000 to 30,000 gallons of storage each. In the small holding vats we hope to rid the effluent of most of the algae cells that are still in the effluent.

After the effluent leaves the third holding vat which provides the last splash system, the effluent comes back above ground and flows over, around, and through small boulders that have been placed into an open channel (again to put in more oxygen). This open channel extends for approximately 250 feet. After open-ditching, the effluent goes back underground through a populated area and on to the receiving stream. On entering the receiving stream there is little or no algae growth and there is little discoloration of the receiving stream as the effluent is discharged.

Just what kind of treatment efficiency is obtained with this multi-lagoon system? Approximately 100,000 gallons per day of waste is being handled which contains approximately 1200 pounds of BOD. Records show that about 97 percent of the BOD and at least 85 percent of the solids are being removed. Two factors have been very critical for effective decomposition. These are temperature and depth of the lagoon.

At 10, 20, and 30 degrees Centigrade, 32, 89, and 96 percent, respectively, of the solids are removed. Temperature has a great deal to do with the predominant bacteria that will appear in a lagoon. Various colors are produced as the predominant bacteria change.

Dissolved oxygen (DO) readings of the final effluent have consistently been above the 4 ppm required in the receiving stream. So far fecal coliform counts have been averaging less than 100/100 ml, thus chlorination has as yet not been required.

CONCLUSIONS:

The use of series lagoons is suitable for the disposal of waste from the poultry processing industry. Within the limits set forth in the design of the research results reported here, it has been demonstrated that adequate disposal can be provided. Perhaps one day additional processes will be added to the design herein described so that the treated effluent can be further treated and then re-cycled through the plant over and over again without any discharge to state waters.

COMMUNICATION IS THE KEY TO SUCCESSFUL ACTION

EARL W. McMUNN

Editor, The Ohio Farmer

The purpose of this seminar was to transfer knowledge from the minds of men who know, into the minds of men who need to know. So this made *communication* the basic element of the entire undertaking.

We talk about communicating. But we spend relatively little time studying how to do it in an effective manner. We've spent millions in research to develop new farm technology. And it has returned handsome dividends. How much have we spent on communications research? Perhaps two or three percent.

Developing new technology is important. No doubt about it. But knowledge is of little value until it is put to use. And it will never be used unless it reaches the minds of those who need to know.

Yes, there is a crying need for more effective communication. We hear about it at every turn. Communication breaks down *within* organizations. It breaks down or has never existed between *different* organizations. All too often we fail to realize what we're missing by failing to communicate.

Here is perhaps our greatest challenge—also our greatest opportunity. Communication is the tool that gets things done. Without it, nothing happens.

For years we have worked at the job of communicating with farm people. And, we've learned how to do this with reasonable success. Scientific knowledge has been carried from the laboratories and the test plots to farms where it was put to use. This is the reason for our modern American agriculture which is the envy of the world. We developed the knowledge. We communicated it in an effective manner.

Now, we are facing a new challenge. We must continue to communicate within our own industry. We must learn to do this in an even more effective manner. We must also communicate with many groups far removed from the field of agriculture. And we don't even know where to start.

What upsets us is that non-farm people are increasingly calling the tune where our vital interests are concerned. This is a result of population shifts brought about by the very bounty of our new agricultural technology. These people no longer understand agriculture. A great many couldn't care less!

So now we have an added job. This is to build understanding with non-farm people. No longer are we on familiar ground. We think we have a message, but we don't know just where to start. Already, agricultural spokesmen have wasted a lot of time talking among themselves in the vain hope that non-farm people just might overhear and understand.

We're a lot like the lady who complains to her husband in a loud voice about a trespassing dog, in the hope that the owner on the next lot

Preceding page blank

will overhear and "take the hint." More direct communication usually is needed.

Public opinion is a powerful tool. It influences lawmakers and sways the decisions of public officials. It causes skirts to drag the ground or shrink to daring skimpiness. It causes people to clamor for an "end to all pollution" even though this is an impossible dream.

We are seeing a host of decisions which affect all of us. Some are made with little knowledge of possible consequences. Available knowledge has not been communicated to the right people, at the right time.

So there is a wave of interest in "telling other people our story." We'd like them to know all about agriculture and to treat our interests with understanding. We even want to tell other people our "problems." Here, we haven't been too successful. And for a very good reason. Other people also have problems. They're not interested in ours. There is no reason why they should be.

The task of this seminar was not to solve all the problems of agriculture. We were there for a specific purpose . . . to talk about animal waste and what to do about it. The simplest answer would be cows making 20,000 pounds of milk a year, and no manure! These aren't developed yet. Until they are, we'd better concentrate on producing the right kind of technical information to handle animal wastes in an acceptable manner, then communicate it effectively.

So we can narrow our communications job down to workable limits. We are concerned about animal wastes. What do farm people need to know? What do the rest of the people need to know? Let's ignore all else as we plan our program of communications.

The knowledge explosion has been a great boon to mankind. From a communications standpoint, it is a handicap. The whole store of knowledge is beyond the power of any single individual to comprehend, much less to convey effectively. And who has the time or inclination to listen? People just don't want to know that much. Nor, is there any reason why they should. We must choose a few basic ideas and concentrate on these.

Here are some questions we must answer:

What, really, is the message we wish to tell?
Why do we want to tell it?
Who do we want to reach?
Who should do the telling?
What "vehicles" must be employed to transport our message?

Who's going to make these decisions? A lot of people must have a part if we are to get the job done. *Perhaps the time is here for a "task force" approach where people with a common interest unite to tell a story.*

There have been many proposals to unite agriculture in a mighty communications effort. Some have actually gotten under way and have had varying degrees of success. But the job for all agriculture is just too big and too complicated to be handled by a single organization. Interests are varied and often conflicting in nature.

Our Animals Waste Communications Task Force could concentrate on one thing. This is animal wastes, and the problem of education and understanding which it involves.

What is known?
Who needs to know?
How are we going to get the information to them?

A successful program of information must be continuing in nature. All too often we attend a seminar of conference. Ideas are batted around. Many of them are good. Fifteen minutes before the meeting breaks up, someone says: "We'd better get this out to the press. Someone should write a release!" Away we go, happy in the knowledge that we have taken care of our obligation to communicate. But nothing happens. A lot more than this is needed if we are to get the job done.

If we're to have an effective task force, it must represent a wide range of interests. Included must even be representatives of the groups we're trying to reach. Who knows better, for interest, how to gain the attention of a lawmaker than does a Congressman or Senator? Who is more likely to understand what sparks citizens' groups to militant action, than a leader of such an organization?

We must not ignore human nature in planning our communications strategies. We'd like to believe people make rational decisions on the basis of scientific fact. At least, that's the way we think we would be influenced. In many cases it doesn't work that way.

When it comes to swaying public opinion, most of us in agriculture are saddled with a severe handicap. We have been schooled in the scientific approach. This assumes you get unbiased information on the basis of research. Then, you use those facts to make rational decisions.

But human nature doesn't always react that way. People are not anxious to get facts which dispute their pre-conceived convictions—especially where emotional issues are involved. We must be backed by truth. If we are to communicate effectively, we must also know how to appeal to emotion and other quirks of human nature.

We're concerned about getting our message to "the public." What we forget is that there is no single "public". There are millions of individuals reacting in a variety of ways. But there are certain basic issues which unite large numbers of people who have a common interest and concern.

One of these major issues of our day is environmental improvement. This phrase means one thing to an alarmist bent on banning some of the major tools of agriculture. The meaning is quite different to a farmer who understands that an improved environment must include all of the things which provide healthy surroundings for plants, animals and people.

We must plan our communications programs on the basis of meaning to the people we're trying to reach. Little or nothing is accomplished by opposing an idea because it will "hurt farmers." Why should other people care? Usually they do not. It's a different story when we can show how *their* environment will be harmed. This means we must sell the idea that everything around us goes to make up our environment. This includes heat, light, food and a host of other things. Eliminating pollution isn't the whole answer. The moon is sterile enough, but it's a poor place for people.

A key principle is to have a message which is relevant, then deliver it in terms the audience will understand. Perhaps you've heard of the fellow who was having trouble with sediment in his water lines. He called a research chemist friend and asked if he couldn't use some kind of acid to clean out the lines. The chemist replied: "The acid might have deleterious effects on the plumbing system."

The man wasn't sure what that meant and didn't like to expose his ignorance, so did nothing. The water dwindled to a trickle. Finally he called a plumber. The plumber arrived. The man explained that he'd asked a chemist about using acid, but had been told it "might have a deleterious effect." "What do you think?" he asked the plumber. "I wouldn't know," the plumber replied. "But there's one thing I *do* know. It will eat hell out of your pipes!" The plumber had all the technical information he needed. What's equally important, he communicated in terms understood by the other fellow.

In Columbus we have one of the nation's great problem-solving organizations. It is the Battelle Memorial Institute. Their experts tell me there is only one real approach to any problem. You must define your objectives, then decide upon a course of action. All too often we fail to start with a clear definition of our problem. We're like the man who lost sight of his objectives, but redoubled his efforts! This is the reason many worthwhile projects are doomed to failure.

We believe we have a message. Here are my suggestions for getting that message delivered to the people who need to know:

Organize an Animal Waste Communications Task Force. It should include representatives of all interested groups.

Decide upon one or more major objectives.

Define the "publics" we need to reach.

Decide upon a message which is relevant for a specific audience.

Deliver the message in terms the audience will understand.

Think communications as a continuing process, not something to be turned on in case of emergency.

The purpose of this seminar is to face the problem of animal wastes and to propose a plan of action. *Certainly, the most important single element must be a communications plan.* What happens in the years ahead will depend upon the decisions of people. Their decisions can be no better than the knowledge they possess.

This country has problems. No doubt about it. We also have answers. The protesters, the agitators and rioters are getting the attention. They are communicating. But they don't have the answers. The answers are to be found in our store of scientific knowledge. But that knowledge is useless unless it is communicated.

Here is our opportunity. It is also our responsibility. People are being deluged with ideas. Many are constructive. Others would limit or destroy the very things which have made America great. It matters not whether this is ignorance or deliberate intent—the result is the same. Information which will help build a better America can no longer be hidden. It's our duty to communicate!

REPORTS AND RECOMMENDATIONS

REPORTS AND RECOMMENDATIONS OF WORKING GROUPS

Discussions and recommendations of the five working groups of the National Symposium on Animal Waste Management are classified under six different subject categories: information programs, education and training programs, technical assistance, financial assistance, research and development, and legislation and regulation.

INFORMATION PROGRAMS

Several major deficiencies in information situations dealing with animal waste management problems have been identified. Broadly speaking, these relate to the needs and concerns of (a) producers of animals and animal products, (b) the general public—either as consumers or those affected in some way by animal waste pollution problems, and (c) research and regulatory agencies.

The desired definitive information either does not exist or is splintered among a variety of Federal and State agencies. It is imperative that these information deficiencies be remedied as speedily as possible.

Recommendations

1. "*A national agricultural-related pollution problem inventory be adequately funded and carried out through existing agencies. Such an inventory should receive the highest priority with a recommended target completion date of June 1973. We recommend that the inventory include data on animal waste pollution problems from all producer sources and that comprehensive data be obtained and correlated at local, State, and National levels and be made available to all interested agencies and public and private groups.*

2. *Create a national data inventory bank on waste management research (both completed and ongoing), and proven technological and ecological data related to animal waste management. It is recommended that this data inventory bank be adequately funded and become operational by July, 1973, and that it should be conducted and operated by an existing agency having adequate and suitable facilities.*

3. *Establish a national animal waste management communication task force to develop a system for providing animal waste management information to farmers and to the public. Membership should be drawn from all Federal and State government agencies concerned with this problem as well as land-grant colleges and universities, agri-business and farm organizations, and the farm press. Task force functions would include:*

(a) *Development of a national animal waste management information exchange center*

(b) *Reviewing and determining available information sources.*

(c) *Recommending improvements for obtaining information on animal waste technology from every possible source.*

(d) *Determining the information needs of different audiences.*

Preceding page blank

(e) *Establishing means of disseminating information especially to the farm press in informing farmers on legislation and regulations regarding animal waste.*

EDUCATION AND TRAINING PROGRAM

Education and training programs related to animal waste management should be initiated and expanded so that (a) effective technology transfer can be implemented at and to all levels, and (b) regulatory agencies can benefit from a two-way flow of information, (c) the public would be better informed on animal waste pollution problems and the efforts being made to control them, and (d) both the public and governing authorities in individual communities can evaluate the merits of rural zoning in maintaining a viable agriculture.

Recommendations

1. *Extension programs at national, State and local levels should receive additional resources (financial and staffing) to provide emphasis on animal waste management. This would include greater activities on demonstration and tour programs.*

2. *The Extension Service should place more emphasis on and give more support to the public affairs aspects of its animal waste management programs to increase tolerance, understanding, and change attitude of both producers and the public.*

3. *There should be more emphasis on training programs and college curricula involving animal waste management problems and solutions. Recognition should be given to those institutions which are adjusting their curricula to provide well-trained environmental scientists with expertise to assist the animal and poultry industries to solve their pollution problem.*

4. *In-service training programs on animal waste management should be expanded for personnel in the private sector and in all Federal and State agencies working with the animal industries, including regulatory agencies. Such programs should be coordinated within and among State and Federal agencies.*

5. *The Extension Service and EPA should develop in collaboration with other agencies a waste management manual for the individual types of confined feeding installations, taking into account the differing geographic, and climatic, sociological and economic conditions throughout the nation.*

TECHNICAL ASSISTANCE

Programs of technical assistance to help producers solve animal waste management problems are currently available through the Soil Conservation Service, The Environmental Protection Agency, the Extension Service, and, to a limited extent, through State government agencies in some states. The SCS provides technical assistance to farmers and ranchers through locally organized soil and water conservation districts in almost all of the agricultural counties of the United States. Technical assistance through EPA consists of providing technical expertise on animal waste matters at the required level, and conducting farm and feedlot demonstration projects. Technical assistance through the Extension Services is in the form of structure and waste handling systems design, plans and construction.

Although the quality of this technical assistance is generally high, technical assistance programs for the most part are available to and directed at the smaller farm, ranch or farm-feedlot operation. In many instances, however, the demand for technical assistance by smaller operators exceeds the supply available. This problem will become more acute in the future as farmers and ranchers attempt to comply with environmental control regulations. Federal technical assistance for the design of individual systems is not usually available to the large beef, dairy, swine and poultry producers. Technical assistance in solving animal waste management problems is a vital part of any comprehensive program of assistance to producers. Few private consulting engineering firms are experienced in animal waste management design.

Recommendations

1. *Technical assistance programs should be broadened, accelerated, and made available to all types of animal producer operations on a*

sustained and readily available basis. This will require increased funding for ongoing technical assistance programs of Federal and State agencies.

2. *An advisory committee with some legal status should be established in each State to advise on legislative matters and in the promulgation of regulations. The committee should be composed of representatives of the various segments concerned with animal wastes management and control, such as producers, assistance agencies, regulation agencies, and academic institutions. These committees would be of material value not only in advising on technical, economic, and socio-economic matters in the development of laws and regulations, but also in disseminating information on the need and reasons for laws and regulations.*

3. *The Environmental Protection Agency should maintain a national center of competence in animal waste management with appropriately trained staff, and each regional office should provide a senior staff officer, with appropriate background and training to maintain liaison with the national center, producers, other Federal, State and local agencies, and other interested parties.*

4. *We recommend that livestock and poultry producers form a common group to represent their interests in animal waste management systems. This group should be active on the national, State, and local level, and would coordinate the overall effort of the producers in matters pertaining to animal waste management. It would also serve as a "sounding board" for the various Federal, State, and local agencies in the development of their programs and regulations.*

FINANCIAL ASSISTANCE

Certain types of financial incentives must be provided producers in order to (1) assist with timely solutions of environmental problems caused by animal waste; (2) prevent unnecessary producer business terminations and resulting economic dislocations; (3) afford producers a better opportunity, as compared to other sectors of the economy, for meeting pollution control standards and regulations.

Producers of animal products are unable to pass on the cost of animal waste pollution abatement practices through the market price mechanism. Some financially sound producer operations have been forced out of business because of pollution abatement regulations and inability of the producer to absorb improvement costs through business income.

Current financial incentives to animal producers for solving animal waste management problems are not adequate to meet present and future needs. Limited financial assistance is now provided producers through Federal programs offering cost-sharing and loans. These programs are operated through the USDA and the Farm Credit Administration and are available in most agricultural counties in the Nation. However, limitations and gaps in these programs deprive producers of the full opportunity needed to meet total waste management costs. For example, the REAP cost-share program limitation of $2,500 is not a sufficient incentive in many cases to induce farmers to proceed with high-cost animal waste control projects. The Farmers Home Administration's lending authority does not include specific provision for loans for pollution abatement measures. Generally, funding for the loans to producers through government agencies is inadequate or is too restricted for many producers.

Federal and State tax credits for installation of pollution abatement measures are not provided for within existing legislation. Depreciation allowances for animal waste handling equipment are unrealistic in view of the high cost of such equipment.

In many cases, public domain actions, expanding urban areas, or new laws are forcing producers out of business. Adequate private financing for relocation of the operator's business often is not available.

Recommendations

1. *Federal and State legislation should be passed to afford animal producers tax credits and realistic equipment depreciation allowances for installation of pollution abatement measures.*

2. *Financial relocation assistance should be made available through existing Federal loan programs to producers forced to move their operation because of pollution abatement laws and regulations, expanding urban development, or public domain actions.*

3. *Present Federal cost-share programs should be revised to include authority for:*

(a) *Cost-sharing for field testing animal waste disposal systems and facilities on privately owned farms to demonstrate the feasibility of pollution abatement practices or procedures developed through on-going research programs.*

(b) *Increased statutory producer payment limitation for cost-sharing programs for implementing animal waste pollution abatement practices (now limited to 50 percent of total cost under REAP).*

(c) *Long-term cost-sharing contracts based on comprehensive environmental improvement plans to secure adequate funding at the time needed and to encourage complete farm pollution abatement systems.*

4. *Legislative authority and funding for an animal waste pollution prevention program which would utilize existing Federal action and research programs and delivery systems. The need is visualized as being in excess of $40 million for technical assistance and research and $160 million annually for cost-sharing for the next five years.*

5. *Expanded Farmers Home Administration legislative authority to include loans for animal waste pollution abatement measures. The authority should be broadened to include all producers, and with limitations raised to reflect current costs, and a low interest rate incentive considered.*

6. *The construction grant program (EPA) should be expanded and broadened to include animal waste handling systems.*

RESEARCH AND DEVELOPMENT

Several research areas need support through changes in legislative authorities, financing, better coordination of research efforts, coordination of research with action programs, or increased emphasis on particular aspects of animal waste management. Research areas needing particular emphasis are the suppression of odors arising from animal producer enterprises, land application technology, and alternative recycling techniques.

The large number of research locations under State, Federal, industrial and private sponsorship appears to present a diffused and unrelated research effort on the problems of animal waste management. There is a need, therefore, for a periodic, critical review of research to aid those engaged in research planning and budgeting.

The physical aspects of confined feeding equipment and facilities need more attention, particularly for the design and installation of facilities which will inherently promote good sanitation and reduce odors. An example would be the utilization of cattle feed bunkers which would not allow the accumulation of feeds and waste materials in areas not amenable to cleaning and removal resulting in putrefaction odors and fly production.

Increased emphasis and financial support should be provided for researching solutions to the organoleptic considerations of confined animal feeding operations. The nuisance factors of odor control are of increasing importance and have not been recognized in positive programming.

Land use planning and management has not been utilized as an effective tool to the benefit of both producer and area resident. Intelligent land use planning should be utilized with primay control at the local level.

Consideration, research, and demonstration of green belt areas and visual screening have the potential of reducing actual and psychological nuisance factors and are deserving of immediate attention.

There is also a need for on-farm research and field testing systems. However, farmers are sometimes reluctant to agree to installation of research or field testing facilities because of damages to farm resources, liability, problems or legal rights to ownership of the facility installed. Measures to overcome these limitations should be obtained to increase the effectiveness of this phase of research and development of animal waste management systems.

Recommendations:

Greater economic research effort is needed to guide public and private investment in environmental improvement and for understanding the economic and social consequences of alternative public actions to improve the environment through animal waste pollution *abatement. Economic studies are needed to estimate the costs and benefits of various prescribed pollution abatement measures, including the impact on the producer, industry, consumer, and environment. Furthermore, economic studies are needed to assess how benefits and costs of abatement measures would be distributed under alternative strategies for implementing programs. Equally important is the need to evaluate different strategies for improving environmental quality from the standpoint of administrative feasibility, cost effectiveness, and social acceptability.*

1. *A research review and advisory committee on animal waste management should be established to provide guidance to EPA and USDA for related research programs. Members should be appointed jointly by the Secretary of Agriculture and the Administrator of EPA. Membership should be drawn from producers, farm organizations, and from the Federal, State, and private research community.*

2. *EPA's present demonstration program to develop and prove new technology should be provided with increased funding to accelerate research and development and implement technology transfer.*

3. *On-farm field research on animal waste management should be increased and supported by direct financial assistance to the farmer as well as liability protection for the farmer and the sponsoring research agency.*

4. *Legislation should be obtained to provide authority and funding to indemnity farmers for damages incurred by the farmer as a result of on-farm field research or field testing of animal waste management systems.*

5. *Legislative authority should be obtained to permit farmers to assume ownership of field-scale research facilities which have been installed on privately owned farms.*

6. *Prepare and analyze models and systems of waste management to be tested by livestock producers to determine the feasibility of technological and management alternatives and to identify further critical research needs.*

7. *Develop economically feasible and reliable safety devices for waste storage to protect humans and animals.*

8. *Evaluate the various alternatives for financing technology required for waste management—cost incentive arrangements, increased direct public support, rapid tax write off, effluent charges, etc.*

9. *To the extent that any federal, state or local health statute, regulation or ordinance pertaining to human health is inconsistent with a federally approved animal waste plan, such plan will not be enforced until such inconsistencies are finally resolved.*

10. *Increased emphasis should be placed on the following areas of animal waste management research:*

(a) *Control of gaseous and particulate emissions from animal waste (ranging from odors through noxious gases to dusts).*

(b) *Development of better criteria for selection of sites for animal production units.*

(c) *Criteria for determining the amount and frequency of application of animal wastes to land that will not result in contamination of the soil-plant-animal production system.*

(d) *Economically and technologically feasible alternatives to land application, including recycling and by-product development.*

(e) *Development of zoning standards and other institutional and legal arrangements to protect livestock production units and related land areas from punitive legal action and encroachment by land uses not sympathetic to livestock production.*

(f) *Development of environmental quality sensing instruments suitable for reliable unattended operation.*

(g) *Development of criteria for use by Food and Drug Administration to determine the safety of using animal waste as livestock feed and to determine the wholesomeness and acceptability of consumer products.*

LEGISLATION AND REGULATION

Throughout all of the regulatory and legislative activities of both State and Federal agencies, there is a need to maintain flexibility because of the variation in production and management systems caused by differences in climate, geography, animal species, site characteristics, nature and scale of the enterprise and even the rations used. Flexibility in authorizing legislation and in the regulatory activities would, therefore, help to avoid conflict and permit orderly adoption to changing technology.

Flexibility, however, could result in such a wide variety of regulations that they become unmanageable. To avoid such an undesirable situation, coordinated guidance should be provided to both legislative bodies and regulatory agencies.

A natural outfall of this need for flexibility is the desirability of strong local and State inputs in the process. The differences as well as the impacts are local and locally understood; thus a strong local input would be desirable.

Protection of the individual producer and his investment in pollution abatement facilities against changing regulations resulting from new technology or standards must be balanced against protection of the total society and its investment.

Enactment of Federal legislation applying to animal waste facilities is the initial step in a series of procedures contributing to the time required for an operator to conform to regulations. After Federal legislation has been adopted, Federal guidelines must be established. Upon adoption of Federal guidelines each individual State also should establish specific guidelines or enact necessary legislation. Some states presently have legislation that will be readily adapted to comply with the Federal requirements; however, it will be necessary for some of the states to adopt new legislation. The time required for this period should consider State legislative procedure requirements.

Following the enactment of Federal guidelines and subsequent State guidelines, an intensive educational and preparatory period will be required both for the regulatory agencies and the individual owners—preferably two years.

Development of a model statute, and the adoption of such statute by those various states faced with significant animal waste management problems, should be encouraged for the following reasons:

- It is debatable whether current State air and water pollution agencies are equipped to fully address animal waste problems, given the scope and uniqueness of such problems.
- Even if such agencies are fully able to handle such animal waste problems, there are other sufficient reasons for adopting State animal waste legislation, including:
  - a. The possibility that such legislation declare the operation of producers in compliance be prima facie evidence that their operation does not constitute a nuisance.
  - b. That State action in this area is preferable to Federal action.
  - c. That compliance will possibly benefit producers in avoiding punitive damages in citizen initiated nuisance actions.

The producer may have difficulty in complying with regulations, since he may not know the solution to his problems, or if he decides to attempt to solve the problems, he has no assurance that his investment will bring adequate solutions on a continuing basis. There is often a lack of coordination and agreement between enforcement and advisory agencies, operating at all levels of government, as to solutions and guidelines that will solve the problem. Some progress in such situations has occurred in states where an ad hoc State committee of State agricultural and pollution-control leaders has been formed.

Recommendations:

1. *The 1899 Refuse Act, as it applies to animal waste pollution, should be recodified to provide that responsibility for implementing the permit procedures be transferred to the Environmental Protection Agency.*

2. *Implementation of the Recodified 1899 Refuse Act should authorize State permit systems which would operate under broad Federal guidelines; actual implementation and enforcement actions should be left to the states. These guidelines should account for regional, State and local diversity in matters of topology, hydrology, soils, weather, and other factors contributing to the uniqueness of various localities.*

3. *Federal funds should be made available for confirmation and expansion of REAP over and above present appropriations for approved waste management practices, and the national maximum payment limitation be doubled from $2,500 to $5,000.*

4. *It is recommended that a proposed statute (Exhibit A), together with suggestions for improvement of various sections thereof, be submitted to the Council of State Governments for leadership in redrafting, and that the redrafted version thereof then be submitted to the Council of State Governments' Committee on Suggested State Legislation for their consideration.*

5. *Agency procedures for review of applications, inspection of potential pollution problem of applicant, and inspection of abatement system should be conducted by qualified personnel. Where regulatory agencies do not possess adequate engineering or scientific qualifications to assess the problem or judge the adequacy of the abatement system, the agency shall accept the assessment or evaluation report of qualified personnel of another agency that possesses the necessary expertise.*

6. *License fees should not cover the operational cost of enforcement programs, but instead should be minimal and cover the cost of issuance only. After compliance, the permit should be indefinite with provisional requirements for changes in ownership, environmental quality programs, and significant changes in size or operating procedures.*

7. *The type of penalties imposed when noncompliance has been established should be limited to (a) fines only in the case of willful and flagrant violations of the intent of the regulations, and (b) shutdown or reduction of operations only when there exists an immediate threat to public health and safety.*

8. *Operating procedures should provide that livestock producers deal with only one agency in complying with environmental quality regulations.*

9. *The Federal Government should not preempt any State from carrying out the provisions of environmental quality regulations.*

10. *There should be uniformity on quality of air, water and solid waste standards, and uniformity on cost-sharing, but programs to attain minimum federal control standards should be left to the states.*

11. *States which have not already enacted legislation should be encouraged to take preliminary legislative action to identify the parameters of the situation in the State, to be followed on a timely basis by appropriate legislation to apply constructive disciplines for animal waste management.*

12. *State legislation should provide protection to those in compliance against harrassing legal action and also provide stability in administration to attain orderly amortization of investment in animal waste management facilities.*

13. *An ad hoc animal waste coordinating committee of recognized leaders should be appointed in each State. Representatives of State regulatory agencies, State and Federal educational, research, technical, and financial resource agencies, industry and producer groups should be members of the coordinating committee. This committee should be charged with the responsibility for improving coordination and cooperation among all groups in the State involved with animal waste problems. It should develop, with well defined goals, a unified approach toward assisting producers in complying with regulations and with waste management problem solving, and in assisting regulatory officials in establishing and updating regulations.*

RECOMMENDATIONS OF NATIONAL MILK PRODUCERS FEDERATION

General Position

The regulation of individual livestock operations should be based on individual adherence to regional waste management guidelines. Appropriate cooperative efforts should be undertaken immediately between the animal livestock industry and government agencies at all levels to develop a system of regional **Animal Waste Management and Water Pollution Prevention Guidelines**. Such guidelines should be recognized by all levels of government as providing a practical and equitable basis upon which to advance regulations protecting water quality standards applicable to streams passing through agricultural areas.

Regional guidelines should serve as national standards to be enforced at the state level through an appropriate state certification program.

Such a plan would serve to emphasize the preventive approach to control of water pollution and provide an equitable basis upon which to evaluate individual efforts to abate pollution.

Recommendations for Development of Regional Animal Waste Management and Water Pollution Prevention Guidelines

The development of regional animal waste management guidelines should be predicated on the principle that an overall conservation plan is essential for the individual farm or ranch enterprise embarking on a pollution prevention program. Animal waste management guidelines must become a part of a systematic approach to develop an overall conservation plan. This is essential because of the interrelationship of waste utilization, recycling, or disposal, with overall farm operations; available soils and appropriate vegetation.

These guidelines should be developed with local, state, and Federal health regulatory agencies to insure compliance with water supplies and health regulations.

Each waste management system must be tailored to the needs of individual owners or operators within the capability of soils and plan cover at the site.

A Pollution Prevention System for Farmers

A contract arrangement between USDA and individuals and groups is most effective in assisting farmers and ranchers to comply with regional waste management guidelines.

Such an arrangement, similar to that employed in the Great Plains Conservation Program, will enable individual farmers or ranchers to develop an overall waste management plan with cooperation and assistance from USDA and EPA. Such a plan will spell out all the structural, vegetative and management practices necessary as part of a complete conservation plan to prevent pollution from the varied operations of the enterprise. With a contract arrangement, it will be possible to schedule installation of the required measures with cost-

Preceding page blank

sharing over a period of years, if necessary, in a logical and acceptable sequence to meet regulatory agency approval.

A firm cost-sharing contract for installation of such a plan will enable a farmer or rancher to efficiently schedule his resources to accomplish pollution prevention objectives.

Agricultural pollution prevention requires a systematic approach. It is imperative that such pollution prevention activities be undertaken with regional waste management guidelines serving as a mechanism for coordinating an overall agricultural pollution prevention program.

Proposed Waste Management Prevention Program

Assumption—An additional $200 million per year over current REAP funding should be appropriated for expenses of a program of research, financial and technical assistance to agricultural waste and pollution producing enterprises. The assistance program would comprise engineering operations, methods of cultivation, growing of vegetation, land utilization, development and acquisition or installation of waste holding, conditioning and disposal facilities, as well as installation of waste utilizing and pollutant management practices and measures. The program would be directed only to agricultural related waste and pollution producing enterprises to be administered by USDA.

Assumption—$40 million for technical assistance and research and $160 million for cost-sharing.

REACTIONS

NED D. BAILEY

Director, Science and Education
United States Department of Agriculture

In listening to the presentations, I find these break down rather evenly into about five categories: (1) A concern about information programs dealing with animal waste management, (2) concern about education and training, (3) concern about technical assistance, (4) concern, of course, about a large number of action programs, and (5) concern about research. I shall comment on only those areas which come closest to my own responsibilities.

In the area of information, I note that the group recommends a communications task force. There is no question about the need for this. One of the great gaps we have in the whole animal waste management area is an inadequate knowledge of what is going on all over this country at any particular time and how to move that information back out to other people so they will know how to respond and react to it. So often we respond with fear and apprehension, simply because we think we are all alone in tackling a particular problem and we don't know what other people are doing. I certainly would encourage that this recommendation be implemented as soon as we can.

In the area of education and training, I would like to see the Environmental Protection Agency (EPA) carry the leadership in sponsoring and developing educational programs. I hope, however, that EPA will see fit to utilize the delivery system of the Cooperative Extension Services in all the states and the universities in order to get these jobs done. The Extension Service is sitting there waiting for the assignment and is quite capable of providing the right kind of support. I say this because I know of the capabilities of Extension groups at the university levels. They have the capabilities to move in areas much broader than just the agricultural aspects of environmental problems. I hope this recommendation can be implemented in that way and pledge the support of our Department.

In the areas of training, I think it would be a mistake from the standpoint of the Federal Government to set up a separate activity in training. Again, let's use our universities and let's use those who are already deeply involved because the training will be not only for federal competence but also for local and State. I am sure that all this can be accomplished if we put it together in a single package.

I separated technical assistance from educational and training primarily because I think this is a little different type of function. It's more or less a one-to-one consultant type of activity. There are a large number of agencies involved in it now, and this should continue to be so. What we need is coordination and leadership so we bring the federal agencies together.

Your discussion groups quite properly recommended coordination in animal waste research programs. I often wonder what people from different disciplines or different interest groups are thinking of when they call for coordination. Often it means coordinate the other fellow but leave me alone to do as I see fit. Or, coordination is sometimes supported as a means to attract more support money. Actually, it would be nice if we could do all of this. There are several agencies involved in research in animal waste management, and there is no question that there is a need at the federal level to bring these agencies together and provide some leadership in this particular area.

Quite frankly, I think the number of research projects is impressive in this area. To say that they are completely unrelated, I don't think is quite true. I believe there needs to be—particularly in the early stages of research activity—some *lack* of relationship so that there is more diversity of initiative appropriate to every different problem. But there is a need for some major projects which can tie together the large number of findings in this whole area—some so-called experimental demonstrations, if you please. There is also a definite need for a well coordinated monitoring program.

Frankly, I would like to see the National Science Foundation (NSF) use their new RANN program to expedite this type of coordination. We have put the challenge to them in some other areas, and I am in favor of putting the challenge to them in this one. If NSF cannot, then EPA and the Department of Agriculture should work this out together. But I think if the National Science Foundation would come in, they could involve some other institutions not now included as well as provide some leadership in this area.

Let me come back to the concept of overall coordination and talk about advisory committees overall. Let us be sure, in the selection of advisory committees, that we don't pick one that ends up with our talking to ourselves. Let us make sure that we get people who are affected by animal waste on these advisory committees, as well as people in the animal industry. And it seems to me that, from the standpoint of federal responsibility, the obligation for initiative to do this lies primarily with EPA. Logically, it belongs there. And if they do organize a leadership group, I pledge the activities of the Department of Agriculture to cooperate to the fullest extent possible.

HONORABLE WILL ERWIN

Consultant to Administrator
Environmental Protection Agency

I want to make it very clear from the outset that I do not speak for the EPA. Although I am a consultant to the administrator, my reaction represents more or less my own viewpoint.

It seems to me that the responsibility of the Environmental Protection Agency is to protect the environment—that's really what the job is all about. And to do this we have to have the good will of the farmer and rural America. I say this because farmers and rural people have proved for years that if they believe in what the government wants to do, it gets done. If they don't, it doesn't get done. Now, farmers are essentially environmentalists and they want to cooperate, but they are *anxious*. All of us who farm are anxious right now. And anxiety can lead to hostility.

So I reflected on this conference, and I thought that, if I should go back home and see the cattle feeders and other livestock men who are close to my farm, what kind of response would get if I gave them the conference results up to this point.

I was thinking of one farmer in particular to whom I would say: "Here is what you can do to protect the environment." He would listen to my message, and then he would say: "If I do all of that, can you assure me that I will be in compliance with everything and that nobody will bother me?"

Reluctantly, I would have to tell him that I couldn't assure him of that. At that point he would likely become a little belligerent. But then he would calm down and he would reflect a little while and say: "I might buy that, but my banker wouldn't".

Granted, I'm giving the probable reaction of an individual who is a little more agressive than some. But he is a pretty smart fellow. After he gets this information, he begins to investigate and learns that there are some major companies who are really doing some highly technical work on recycling of feedlot waste, that they may have broken down lignin or cellulose which would really revolutionize the livestock feeding business, particularly the major feedlots. But this farmer I know finds that the equipment in question will be very expensive and that any advantage would go to the big feedlot operator; thus, leaving him out of the picture. At that point, he is about ready to throw in the towel.

Then he recognizes that if they make this substitution and if this recycled feed is really as cheap as alleged to be by some people, then he is going to lose some of the market for what he produces in the field. Now, he *can* face this competition, and he *will*. But he is going to be scared and he is going to be anxious about what is going to happen.

Herein is where I see our greatest challenge—the challenge of technology, particularly for the family-type operator, and the real economic and sociological stress that this technology will likely bring.

HONORABLE DON W. MOOS

Director, Washington (State) Department of Agriculture

I recall that just a short six years ago a resolution was passed at our annual convention suggesting that some type of meeting of this nature take place. Even at that time there was a great hue and cry about the problems of our environment.

What are we talking about when we speak about solid waste disposal? Well naturally we are talking about the environment. But I am reminded after having served a good many years on the State Water Pollution Commission and the State Air Pollution Agencies, that in the main we are talking about the same thing in rural America as they have talked about and done a few things about in urban America—cleaning up the Nation's water. Rural America has sewage problems and we have runoff problems, and whether we are going to be able to cope with them in the next ten minutes or the next ten years, depends upon research.

In the State of Washington, where we've always raised a lot of wheat, we used to put that head of wheat on about six foot of straw, and then at harvest time we would have to go in and burn that straw to get rid of it. Of course the hills were open for soil erosion and we had runoff.

We took this problem to the research laboratories at Washington State University—probably many other universities in America worked on the same problem—and they came up with what we call a shorty wheat. Now, in those same draws, we have a much shorter-strawed wheat and the farmers do not have to burn after harvest. They are able to keep the residue on the sides of the hill. All this came about by research.

Research, likewise, is one of the answers to our present problem of animal waste management. And if this research develops, we are going to need demonstrations and educational programs, because the proof of the pudding is the motivation that our farmers and our rural people must have. Pride of getting the job done is going to rest in the area of our extension and our educational forces.

When we get all these things done, regulatory agencies must step in. I would hope that we might use, in effect, the classic stick and carrot principle. The stick, in this case, is the proper type of regulatory legislation.

Thinking back a year or so when we were working with Dr. Bayley and some of my colleagues in the decentralizing effort of the U. S. Department of Agriculture, I am reminded that here we have an opportunity with a new agency, the Environmental Protection Agency, which has indicated it is hoping to start out on the basis of decentralization. So I hope the Congress takes the advice and builds into their proposal and legislative directives to the new agencies the opportunity to truly use a cooperative effort—a cooperative effort of Federal and State regulatory approaches. The job is too big for any one agency or one level of government to accomplish.

Federal-State cooperation has proved to be workable in other areas where desirable standards need to be established—such as meat inspection, food and drug regulations and food processing. But when we're dealing with standards for our environment, the legislation should be written so that the states that are capable and willing to participate should be the enforcement agencies. Because as we start dealing with the millions of farmers and rural people in the Nation, they are going to want to talk to their local people to be able to resolve some of these complicated problems. Their state Senators and State legislators are going to want to consult with their local administrators. And we must remember that, for a farmer or a State legislator, his State capital is much closer to him than the Nation's capital here in Washington.

I've been discussing the "stick;" now let's consider the "carrot." We talked about the Small Business Administration, we talked about farm credit, we talked about many other ways of assisting farmers to make the expenditures that will be coming out of their pockets. Now, I may be way out on this, but I am reminded again of the years I spent on our water pollution control commission. One of the things we did was to allocate the money the Federal government gave us in the State of Washington on the basis of a criteria that we set forth for the municipalities. When a block grant came to our State, we would determine whether there was a need in a particular municipality, whether the engineering work had been completed, and whether other requirements had been met. Then we would allocate funds—a ratio of Federal to State moneys—to that municipality. That was how the block grant to the state was handled.

Now, when you look at a municipality, if it has a food processing plant in it and that food processing plant has an effluent going out, it uses that municipality's sewage disposal system. But what if that company had decided to build its food processing plant eight miles down the road? How does it approach the problem? It appears to me that whether your business is in a municipality or outside it, whether you operate a feedlot or a food processing plant, we are going to have to have an arrangement of federal grants. They speak of the 50 billions of dollars that it's going to take to clean up America; part of that sum will have to be appropriated in the areas of sewage control and runoff problems in the rural areas.

I hope that we in America will put our money where our mouth is and make the direct appropriations for research, for education, for demonstration and action programs so that we can meet the challenges that will have to be faced in the next few years.

HONORABLE JOHN C. CROFOOT

State Senator, Kansas
Cedar Point, Kansas

Sometimes too much knowledge and not enough experience is a handicap and very dangerous. Our regulatory agencies sometimes in their enthusiasm lose the legislative intent of the original act in that as they start making regulations they build on and make the act more stringent.

I believe that we now have the cart before the horse where regulations are pulling the technology instead of technology setting the regulations. The government agencies are now setting regulations and then doing experiments to try and find ways to meet the regulations already set.

We as an industry or any industry for that matter must have some stability of regulations. We cannot comply today with the fear of being out of compliance six months from now always hanging over our head.

There seems to be two programs now, one called Reap for the small producer where he gets aid through the ASC Office up to 50% of the cost as long as it is not over $2,500.00. The one for the large producer could logically be called Rape as he is expected to go it alone with no assistance.

The thing that amazed me, the majority of our Group D was in favor of tax credits or at least a fast depreciation schedule. There was some objection to these ideas, but as I looked around to see who was on the negative side, everyone was a Federal or a State employee. Why would these people, whose job it is to enforce the regulations and get people into compliance be against a program that would make their job easier.

Laws should be broad so that we might have flexible regulations to fit individual states and areas. It is hard to legislate in specifics and the legislature has to depend on the regulatory agencies to use good judgement and the advice of people who have experience.

Our land grant colleges have the knowledge and the experience. I feel that in a great many cases they are not being heeded. We need to be able to deliver the technology before the regulations.

Long established practices should be the individuals responsibility. New structures required by environmental regulations need to be subsidized by tax credits or other forms of relief besides direct payments.

It is my belief that an individual will make better use of his construction dollar if he has to deduct this from his profit and not have the attitude that what the hell, the government is paying one-half of it.

These pollution control structures are not going to add any economy to production nor value to the end product.

According to all statements made they are to benefit the population as a whole. Therefore, I believe the tax credits let the population as a whole help pay the cost. The producer will be saddled with the additional operating expense involved, which the extent of will vary with the area in which he is located. This should be enough of a penalty on the producer.

I believe technology and demonstrated workability of disposal methods must be shown prior to the shut down of existing operations except in cases that can be definitely proven to be eminent hazards.

I would hope before odor standards are devised that much more research will be done, for it is beyond my comprehension how you can measure the plus and minus factors of an aroma.

In my opinion in no way can a Federal agency adopt regulations that apply to our nation as a whole in regard to water quality standards, as each state and stream must be considered on an individual basis. Some of the water quality standards are now higher than they were when the pioneers traveled the prairies. Is this being realistic? These must be established looking at the rainfall of the area, the land use, the type of terrain and soil type as well as where is the water going and what is its ultimate use. I predict that it will be necessary in the next 20 years not only to zone land use, but also streams and rivers will be zoned for use as agriculture, livestock feeding, recreational and for domestic water supply.

Each stream and lake has the capability and the need to absorb and utilize a certain amount of what we call animal waste. In my opinion, producers do not want to pollute as they have grown up and lived in this area, but they do need the assistance of Federal and State agencies to establish guidelines and proven methods with which they can comply before they are willing to spend their mone.

Already, agriculture is an underprivileged industry. To burden it with a public project of cleaning up our streams and rivers at this time when it is at its lowest ebb, while admittedly Washington, D. C., the headquarters of the very people telling us to clean up, is still dumping 30 million gallons per day of raw sewage into the Potomac River, is like the pot calling the kettle black.

GLENN H. BECK

Vice-President for Agriculture
Kansas State University

Having just returned to this country not long ago from a two-and-a half year assignment in Africa, I was surprised at the depth of feeling that has developed concerning environmental control. In Africa, we didn't hear much about this so it is rather striking to come back and watch television and hear radio comments dealing so strongly with problems of pollution control. I fully subscribe to the viewpoints expressed by some in this conference that we better take a hard look at this because there are people talking about environmental controls who are a long distance from the farm. There are dangers from over zealous, poorly informed people that could be damaging to agriculture. We in agriculture must rise to the occasion and place before the public the kinds of facts that are needed to make sound judgements.

We in the land-grant university system—have a threefold responsibility—that of training, research and extension. In the area of training, emphasis is shifting in the direction of providing more subject matter on environmental control. This runs throughout our university. One of the real fortunate things I have seen in all of this is that students are now reacting about environment instead of reacting about some of the other things that they were a few years ago. We also are seeing, in a number of universities, curricula set up specifically to offer training in natural resource conservation and management. This is important because I feel very strongly that we need more people with an agricultural background who are engaged in this kind of work.

In the area of research, we perhaps are guilty of not doing enough research early enough. Our concern over the years has been strongly oriented towards production agriculture, but there has been a change in the decade of the 60's and more and more universities are engaging in environmental control and pollution abatement research of various kinds. Also, there is concerted effort to consider some of these problems on a regional basis. There is a regional project in the northeastern region, one in the north-central region, and another in the Great Plains. This simply means that the universities *are* pooling their resources and knowledge to get at this problem jointly. In my judgment, animal waste management is a subject that is area located. You cannot do research in Washington or New York City in all phases of pollution control and have it apply throughout America. It's got to be done in the geographic area where it is to be applied, so the regional approach should be followed.

One of the working groups in this symposium suggested that inventory banks be created. I subscribe to this idea, and I think it is the right approach. The National Science Foundation would be a good agency to provide some of this overall coordination. I would call to your attention that coordination is already available to a considerable extent through the State experiment station system and the Cooperative State Research Service.

Now, as far as our extension service responsibility is concerned, I would cite three areas of concern. It has responsibility, first and foremost, in serving the rural family, the farm, and the agricultural business firms, providing them with new technology that they can apply in their businesses.

In addition the extension service has a responsibility to inform our legislators. To provide them all the information we have so they are armed to enact better legislation. Finally there is the responsibility to inform the public, to provide facts about the role of agriculture in maintaining a desirable environment. Significant progress is being made in this direction. Cooperative Extension services are recognizing this as a problem and I think you can anticipate that we will be providing more educational materials to the general public for their use.

LIST OF PARTICIPANTS

Dr. D. C. Acker, Dean of College
of Agriculture & Biological Science
South Dakota State University
Brookings, South Dakota 57006

Mr. John B. Adams
National Milk Producers Federation
30 F Street, N. W.
Washington, D. C. 20001

Mr. William B. Anthony
Agricultural Experiment Station
Department of Animal Science
Auburn, Alabama 36830

Mr. William Arledge, Director
Field Services and Quality Control
Dairymen, Inc.
200 W. Broadway, Suite 506
Louisville, Kentucky 40202

Mr. Arthur Armstrong, Director
Special Programs
Small Business Administration
1441 L Street, N. W.
Washington, D. C. 20416

Mr. Pat Augustine
Shelby, Nebraska 68662

Honorable George Baker, Representative
309 North Texas Street
Fort Stockton, Texas 79735

Dr. Maurice E. Baker
University of Nebraska
Agricultural Experiment Station
Lincoln, Nebraska 68503

Professor L. B. Baldwin
Agricultural Extension
Agricultural Engineering Department
Gainesville, Florida 32601

Mr. Gerald Baliles
Office of the Attorney General
Supreme Court; Library Building
Richmond, Virginia 23219

Honorable B. Dale Ball, Director
Michigan Department of Agriculture
Lewis Cass Building, 6th Floor
Lansing, Michigan 48913

Mr. R. C. Barnes
Soil Conservation Service, USDA
South Building, Room 5250
Washington, D. C. 20250

Mr. Forrest L. Beach, President
Florida Association of Soil & Water
Conservation
P. O. Box 427
Trenton, Florida 32693

Dr. G. H. Beck, Vice President
for Agriculture
Kansas State University
Manhattan, Kansas 66502

Mr. William H. Bender
Soil Conservation Service, USDA
South Building, Room 5205
Washington, D. C. 20250

Mr. Thomas W. Bendixen
Div. of Technical Operations
Office of Solid Waste Management Programs
Environmental Protection Aency
5555 Ridge Avenue
Cincinnati, Ohio 45213

Mr. Virgil D. Beougher
District Conservationist
Soil Conservation Service
Ellsworth, Kansas 67439

Preceding page blank

LIST OF PARTICIPANTS

Mr. Norman A. Berg, Associate
Administrator, SCS
U.S. Dept. of Agriculture
South Building, Room 5103
Washington, D. C. 20250

Mr. Harold Bernard
Office of Research & Development
Environmental Protection Agency
1901 N. Fort Myer Drive
Arlington, Virginia 20460

Mr. Marvin Berschet
8396 Clifton Road
South Charleston, Ohio 45368

Mr. Joseph P. Binick
Economic Research Service
U.S. Dept. of Agriculture
500 — 12th Street, S. W., Room 417
Washington, D. C. 20250

Mr. A. L. Black
Texas Assoc. of Soil & Water
Conservation Districts
Friona, Texas

Representative Stewart Bledsoe
Route 3
Ellensburg, Washington 98926

Mr. Gary Bottomley
Holly Farms
Box 88
Wilkesboro, North Carolina 28697

Mr. Clyde A. Bower, Chief
Regulatory Services
Oklahoma Department of Agriculture
122 State Capitol Building
Okalhoma City, Oklahoma 73105

Dr. Robert P. Botts, D.V.M.
Environmental Protection Agency
Research Triangle Park, North Carolina 27711

Mr. Oscar Bredthauer
203 E. 22nd Street
Grand Island, Nebraska 68801

Professor Ted J. Brevik
Agricultural Extension
Agricultural Engineering Department
Madison, Wisconsin 53706

Mr. Patrick Brown
6400 Goldsboro Road, Suite 216
Bethesda, Maryland 20043

Representative Steve Burgess
Route 1, Box 98
Nacogdoches, Texas 75961

Mr. Randel Burson, Director
National Association of Conservation
Districts
Route 2
Schoolcraft, Michigan 49087

Dr. Allen F. Butchbaker
Agricultural Experiment Station
Agricultural Engineering Department
Stillwater, Oklahoma 74074

Dr. T. C. Byerly, Assistant Director
Science and Education, USDA
Administration Bldg., Room 312-E
Washington, D. C. 20250

Mr. William Camp
Gold Kist Poultry
P. O. Box 2210
Atlanta, Georgia 30301

Mr. S. Mason Carbaugh, Director
Rural Resource Services
Virginia Dept. of Agriculture and
Commerce
P. O. Box 1163
Richmond, Virginia 23209

Mr. Robert Carlile
Washington State University
Pullman, Washington

Mr. Virgil P. Carlson
County Extension Agent
Extension Service
Ellsworth, Kansas 67439

Representative Rudy Chmura
71 Chauncey Drive
Springfield, Massachusetts 01229

Mr. Dan Cain
Doane Agriculture Reporter
St. Louis, Missouri

Mr. Wm. Stanwood Cath
Exeutive Secretary
National Assoc. of State Departments
of Agriculture
1616 H Street, N. W., Suite 401
Washington, D. C. 20006

Honorable Donald Christy
Box 278
Scott City, Kansas 67871

Mr. Richard D. Chumney, Executive
Assistant to the Secretary
New Jersey Dept. of Agriculture
P. O. Box 1888
Trenton, New Jersey 08625

Mr. Joseph W. Claybaugh
Dekalb Ag. Research, Inc.
Sycamore Road
Dekalb, Illinois 60115

Mr. R. Deane Conrad, Special Assistant
Council of State Governments
1735 DeSales Street, N. W.
Washington, D. C. 20036

Colonel John H. Cousins, USA
Office of the Chief of Engineers
Department of the Army
Washington, D. C. 20314

Dr. Andrew Cowan
Department of Agriculture Engineer
University of Maryland
College Park, Maryland

Honorable John C. Crofoot, Senator
Cedar Point, Kansas 66843

Dr. William Crosswhite
Economic Research Service, USDA
500 — 12th Street, S. W., Room 408D
Washington, D. C. 20250

Dr. Alvin Dale
Agricultural Experiment Station
Purdue University
Lafayette, Indiana

Mr. P. R. Datta
Environmental Protection Agency
Washington, D. C. 20242

Mr. Velmar Davis
Farm Production Economics Division
Economic Research Service, USDA
500 — 12th Street, S. W., Rm. 350
Washington, D. C. 20250

Mr. Jeffery Denit
Office of Research & Development
Environmental Protection Agency
1901 N. Fort Myer Drive
Arlington, Virginia 20460

Dr. Rollin M. Dennistoun, Coordinator
Environmental Quality Concerns
Minnesota Department of Agriculture
530 State Office Building
St. Paul, Minnesota 55101

Mr. Russell E. Donovan
RFD 1, Box 175
Milton, Delaware 19968

Mr. Alex Dorsch
R. R. 2
La Junta, Colorado 81050

Dr. John Droge
Office of Water Programs
Environmental Protection Agency
Washington, D. C. 20242

Mr. Leslie Droge
Seneca, Kansas

Mr. Van E. Eitel
Economic Research Service, USDA
Washington, D. C. 20250

Mr. Matt Engler
Route #1
Mt. Pleasant, Michigan 48858

Mr. Ted Erikson
IIT Research Institute Chemistry
10 West 35th Street
Chicago, Illinois 60616

Honorable Will Erwin
Consultant to the Administrator
Environmental Protection Agency

Mr. Lloyd Essick
Kanopolis, Kansas

Honorable J. James Exon, Governor
of Nebraska
State Capitol
Lincoln, Nebraska 68509

Mr. Doug Florence
Stratford of Texas
Box 28
Stratford, Texas

Mr. Raymond L. Fox
Farm Cooperative Service, USDA
500 — 12th Street, S. W.
Washington, D. C. 20250

Mr. Robert M. Frederick
National Grange
1616 H Street, N. W.
Washington, D. C. 20006

Mr. Mark Freeman
Executive Assistant
Box 1609
Jackson, Mississippi 39205

Mr. Richard G. Ford
Extension Service, USDA
Washington, D. C. 20250

Mr. J. Marvin Garner
Executive Vice President
Pork Producers Council
4715 Grand Avenue
Des Moines, Iowa 50312

LIST OF PARTICIPANTS

Honorable T. Ed Garrison, Senator
Route 2
Anderson, South Carolina 29621

Mr. Albert Gehlbach
Rural Route 3
Lincoln, Illinois 52656

Mr. Charles Gentry
Environmental Protection Agency
4219 Minton Drive
Fairfax, Virgina

Dr. Donald Gillette
Office of Air Programs
Environmental Protection Agency
Research Triangle Park, N. C. 27711

Mr. Nicholas M. Golubin
Environmental Protection Agency
Washington, D. C. 20460

Mr. Ken Goodrich
USDA, ASCS
Room 5-W Administration Building
Washington, D. C. 20250

Mr. Jay Gould
California Farm Bureau
2855 Telegraph Avenue
Berkeley, California 94705

Honorable Billy Ray Gowdy, President
Oklahoma Dept. of Agriculture
122 State Capitol Building
Oklahoma City, Oklahoma 73105

Mr. J. B. Grant
National Assoc. of State
Department of Agriculture
1616 H Street, N. W., Suite 401
Washington, D. C. 20006

Mr. Melville W. Gray
Chief Engineer and Director
Division of Environmental Health
State Office Building, 5th Floor
Topeka, Kansas 66612

Mr. Jack R. Grey
Office of the Secretary
U.S. Dept. of Agriculture
Administration Bldg., Rm. 213-E
Washington, D. C. 20250

Honorable J. S. Guy, Jr.
Commissioner, St. Mary's County
Court House
Leonardtown, Maryland 20650

Mr. Charles J. Hajinian, Chief
Program Planning Branch
Office of Air and Water Programs
Environmental Protection Agency
1911 Walnut Street
Kansas City, Mo. 64106

Mr. James E. Halpin
Agricultural Experiment Station
Clemson, South Carolina 29631

Mr. William E. Hancock
REAP Specialist
U. S. Court House, Room 579
Nashville, Tennessee 37203

Mr. Keith Handy
RD #1
Fort Plain, New York 13339

Mr. Edward H. Hansen
Acting Assistant to the Secretary
Intergovernmental Affairs
U.S. Dept. of Agriculture
Administration Bldg., Room 213-E
Washington, D. C. 20250

Professor Milton Heath
Institute of Government
University of North Carolina
Chapel Hill, N. C. 27514

Mr. Burdet Heinemann, Vice President
Research & Development
Mid-America Dairymen, Inc.
P. O. Box 1837, S.S. Station
Springfield, Missouri 65808

Mr. Bobby C. Heitschmidt
County Executive Director
Ellsworth County, ASCS Office
Ellsworth, Kansas 67439

Mr. Tom Herrich
P. O. Box 2009
Amarillo, Texas 79105

Dr. Dixon Hubbard
Science and Education Staff, USDA
Washington, D. C. 20250

Honorable P. L. Hughes
Representative
Box 188
Madison, Mississippi 39110

Mr. Luiken H. Huisman, Director
Institute for Farm Buildings and
Agricultural Construction
#12 Dr. S. O. Mansholdlaan
Wageningen, The Netherlands

Dr. F. J. Humenik
Agricultural Experiment Station
Agricultural Engineering Department
Raleigh, North Carolina 27607

Mr. Ray Hunter
ASCS, USDA
South Building, Room 3096
Washington, D. C. 20250

Mr. J. Robert Holloway
Environmental Protection Agency
Cincinnati, Ohio

Mr. Raymond Jaeger
Maryland ASC State Committee
Randallstown, Maryland

Mr. Woodrow Jenkins, Poultry Scientist
Extension Service, USDA
South Building, Room 5509
Washington, D. C. 20250

Mr. J. R. Johnston
ARS-SWC, USDA
Southern Plains Branch Headquarters
Bushland, Texas 79012

Mr. William Johnson
The Progressive Farmer
Raleigh, North Carolina

Honorable Bernard Keene
Representative
Route 1
Bardstown, Kentucky 40004

Dr. M. P. Kelsey, Extension Economist
Michigan State University
East Lansing, Michigan 48823

Mr. Leo Kennedy
Council of State Governments
Iron Works Pike
Lexington, Kentucky 40505

Mr. John Killam
Route #1
Jacksonville, Illinois 62650

Mr. R. W. Kleis
Associate Director
Agricultural Experiment Station
Lincoln, Nebraska 68503

Dr. John Kolega
Agricultural Extension Station
Agricultural Engineering Department
Storrs, Connecticut 06268

Mr. William Krejci
Fairmont, Nebraska 68354

Mr. Keith A. Kreul
Wisconsin State Defense Board
State ASCS Office, USDA
Madison, Wisconsin 53711

Honorable Glenn W. Kruescher, Director
Nebraska Dept. of Agriculture
P.O. Box 4844
Lincoln, Nebraska 68509

Mr. William Earl "Pete" Lane
North Carolina Department of Agriculture
P.O. Box 27647
Raleigh, North Carolina 27611

Dr. Walter Langston
425 Volker Boulevard
Kansas City, Missouri 64110

Mr. Steve Larson
Hoard's Dairyman
Fort Atkinson, Wisconsin 53538

Mr. Donald Last
Environmental Agent, Dane County
City-County Building, G-R 17
Madison, Wisconsin 53709

Mr. W. C. LaVielle
Office of Water Quality Programs
Environmental Protection Agency, Region V
Chicago, Illinois 60606

Mr. Larry Lawson
State Water Control Board
P.O. Box 11143
Richmond, Virginia 23230

Mr. James E. Lee, Director
U.S. Dept. of Agriculture
Farm Ownership Loan Division, FHA
South Building, Room 5332
Washington, D. C. 20250

Mr. Lyle Liggett
1900 Columbia Pike
Arlington, Virginia

Mr. Alan S. Lessin
Environmental Protection Agency
Crystal Mall Bldg. 2
1921 Jefferson Davis Highway
Arlington, Virginia 20460

Assoc. Prof. Don R. Levi
Washington State University
Dept. of Agricultural Economics
Pullman, Washington 99163

Mr. Bob Lilly
Assoc. Milk Prod. Inc.
San Antonio, Texas

LIST OF PARTICIPANTS

Professor R. I. Lipper
Agricultural Experiment Station
Agricultural Engineering Department
Manhattan, Kansas 66502

Dr. R. C. Loeher
Agricultural Experiment Station
Aricultural Engineering Department
Cornell University
Ithaca, New York 14850

Mr. Gene Logsdon
Farm Journal Magazine
Philadelphia, Pennsylvania

Dr. Ralph (Skip) Luken
Program Development, OMP, EPA
4th & M Streets, S.W., Room 3006
Washington, D.C. 20460

Mr. Jesse Lunin
USDA, ARS
Beltsville, Maryland 20705

Mr. Max Maberry, District Director
Montana ASCS, USDA
Hilger, Montana

Mr. Kenneth M. MacKenthon, Acting Director
Division of Technical Support
Office of Water Programs
Environmental Protection Agency
Washington, D. C. 20460

Mr. Don F. Magdanz, Exec. Secretary-Treasurer
National Livestock Feeders Association
309 Livestock Exchange Bldg.
Omaha, Nebraska 68107

Mr. Charles R. Malone
National Academy of Science
2101 Constitution Avenue, N. W.
Washington, D. C. 20418

Dr. Richard T. Marks
USDA, Extension Service
Room 3247, South Building
Washington, D. C. 20250

Mr. Edwin E. Marsh, Executive Secretary
National Wool Growers Association
600 Crandall Bldg.
Salt Lake City, Utah 84101

Mr. Richard McGuire
American Farm Bureau Federation
Cambridge, New York 12816

Mr. Clifford G. McIntire, Director
National Resources Department
American Farm Bureau Federation
425 - 13th Street, N. W.
Washington, D. C. 20004

Delegate James M. McKay
Hollywood
Leonardtown, Maryland 20650

Mr. John McKinney
The Progressive Farmer
Birmingham, Alabama 35202

Mr. C. W. McMillan, Exective Vice President
American National Cattlemen's Assoc.
1015 National Press Bldg.
Washington, D. C. 20004

Mr. Earl W. McMunn
Editor, The Ohio Farmer
1350 West Fifth Avenue
Columbus, Ohio 43212

Mr. A. F. McRorie
North Carolina Department of
Water and Air Resources
Raleigh, North Carolina

Mr. Ron Miner
Iowa State University
Ames, Iowa

Honorable Donald W. Moos, Director
Washington State Department of Agriculture
P.O. Box 128
Olympia, Washington 98501

Mr. S. M. Morrison
Agricultural Experiment Station
Ft. Collins, Colorado

Assoc. Professor A. J. Muehling
Agricultural Extension
Agricultural Engineering Dept.
Urbana, Illinois 61801

Representative Fred Mulenix
Route 3M
Weston, West Virginia 26452

Mr. Carl E. Nall, Executive Director
Pacific Egg and Poultry Assoc.
5420 West Jefferson Boulevard
Los Angeles, California 90016

Mr. Arthur S. Newman
USDA, CSRS
Room 439W, Admin. Bldg.
Washington, D. C. 20250

Mr. John F. Nicholas
U.S. Dept. of Agriculture
C&MS Inf. Div., Rm 1758 So. Bldg.
Washington, D. C. 20250

Honorable Donald Northrup, Senator
Star Route
Powell, Wyoming 82435

Professor E. A. Olson
Agricultural Extension
Agricultural Engineering Department
Lincoln, Nebraska 68503

Mr. Dale E. Oyster
Technology Director
Environmental Protection Agency
4th & M Sts., S.W.
Washington, D. C. 20242

Mr. Lloyd E. Partain
USDA, SCS
Room 6111
Washington, D. C. 20250

Mr. Charles A. Paul
C&MS, Office of the Administrator, USDA
Washington, D. C. 20250

Mr. John C. Pierce
USDA
C&MS, Room 2631 South Bldg.
Washington, D. C. 20250

Honorable John W. Powell, Senator
RFD 2
Liberty, Mississippi 39645

Dr. George L. Pratt
Agricultural Experiment Station
Fargo, North Dakota 58102

Mr. Albert (Burt) C. Printz
Environmental Protection Agency
Chief, Federal Activities Branch
Crystal Mall, Bg. 2, Room 1000
1921 Jefferson Davis Hwy.
Arlington, Virginia 22202

Mrs. Lotus Prokop
USDA, OGC
Room 1307 South Building
Washington, D. C. 20250

Mr. Stanley Quackenbush, Dep. Director
Michigan Dept. of Agriculture
Lewis Cass Office Building
Lansing, Michigan 48913

Mr. Don Race, Director
Laboratories and Quality Control
Dairylea Cooperative Inc.
420 Park Street
Syracuse, New York 13208

Mr. William Rawls
Environmental Protection Agency
Washington, D. C. 20242

Mr. Randall Reeder
West Virginia Dept. of Agriculture
State Capitol
Charleston, West Virginia 25305

Mr. Ronald Ritter
Environmental Protection Agency
Office of Water Programs
911 Walnut Street
Kansas City, Missouri 64106

Dr. J. S. Robins
USDA, CSRS
Adm. Building, Room 313A
Washington, D. C. 20250

Honorable Jim Buck Ross, Commissioner
Mississippi Dept. of Agriculture
Box 1609
Jackson, Mississippi 39205

Mr. William J. Sallee
U.S. Dept. of Agriculture
ASCS, South Bldg., Rm. 3099
Washington, D. C. 20250

Dr. Paul E. Schleusener
USDA, CSRS
Admin. Bldg., Room 443W
Washington, D. C. 20250

Mr. William Semerod
Dairylea
Syracuse, New York

Mr. William C. Shilling
Environmental Protection Agency
Division of Technical Support
Office of Water Programs
Washington, D. C. 20242

Mr. Arden Shisler
Route #1
Dalton, Ohio 44618

Mr. Lynn Shuyler
Environmental Protection Agency
Water Quality Office
P.O. Box 1198
Ada, Oklahoma 74820

LIST OF PARTICIPANTS

Mr. Jim Smathers, Director
Maryland & Virginia Milk Producers Association
P.O. Box 9154, Rosslyn Station
Arlington, Virginia 22209

Mr. Gardner P. Smith
USDA, ASCS
Room 3601 South Bldg.
Washington, D. C. 20250

Mr. Lewis Smith
USDA, ARS
Room 106, Bg.-173
Beltsville, Maryland 20705

Dr. R. E. Smith
Agricultural Experiment Station
Agricultural Engineering Dept.
Athens, Georgia 30601

Dr. Gordon Snow
California Dept. of Agriculture
1220 N Street
Sacramento, California 95814

Mr. Keith Snyder
Environmental Protection Agency
Div. of Planning and Interagency Programs
Office of Water Programs
Washington, D. C. 20242

Mr. Lynn Stalbaum
Associated Dairymen
1026 17th Street, N.W.
Washington, D. C. 20036

Mr. Fred Stein
Department of Commerce (NIPCC)
14th St. & Constitution Avenue, N.W., Rm. 4424
Washington, D. C. 20230

Mr. J. W. Stiles, Vice President for Development and Environmental Quality
Agway, Inc.
Box 1333
Syracuse, New York 13201

Dr. Roger Strohbehn
Room 420 500 12th St., S. W.
Washington, D. C. 20250

Mr. L. Dean Strowig
Area Engineer
Division of Environmental Health
Area 5, North Central
215 West Cloud
Salina, Kansas 67401

Dr. Gene L. Swackhamer
Farm Credit Administration, USDA
Room 6847 South Building
Washington, D. C. 20250

Dr. John Sweeten
Environmental Protection Agency
Office of Solid Waste Management Programs
5555 Ridge Avenue
Cincinnati, Ohio 45213

Mr. Dick Taylor
Plantation Foods, Inc.
P.O. Box 887
Waco, Texas 67603

Mr. J. Taylor
Department of Health, Education and Welfare
5600 Fisher's Lane, Room 7B-18
Rockville, Maryland 20852

Mr. Robert Teitler
Publication Management Corporation
1101 - 16th Street, N. W., 3rd Flr.
Washington, D. C.

Mr. Clifford Tinklepaugh, President
Pennsylvania Association of Soil and Water Conservation Districts
R.D. 1
Thompson, Pennsylvania 18465

Mr. John Trotman, First Vice Pres.
American National Cattlemen's Assoc.
Montgomery, Alabama

Dr. William A. Truban, Senator
Virginia State Senate
Woodstock, Virginia

Hon. A. B. Vanlandingham, Senator
Missouri State Senate
Columbia, Missouri 65201

Mr. Dean Vatthauer, Director
Farmers Union Marketing and Processing Association
Redwood Falls, Minnesota 56203

Dr. Frank Viets
102 Yale Way
Ft. Collins, Colorado

Mr. David Wagoner
Environmental Protection Agency (OMP)
4th & M Street, S. W., Room 30006
Washington, D. C. 20242

Honorable Willard Waldo
State Representative
DeWitt, Nebraska 68341

Honorable Robert H. Walling, Senator
1001 Oxford Road, N.E.
Atlanta, Georgia 30314

Dr. David J. Ward
USDA, S&ES
Adm. Bldg., Rm. 315-E
Washington, D. C. 20250

Mr. Richard Watkins
Environmental Protection Agency
Office of Water Programs
Washington, D. C. 20242

Mr. W. T. Welchert
Agricultural Extension
Agricultural Engineering Department
Tucson, Arizona 85721

Dr. R. L. Wesley
Extension Poultry Processing Technologist
VPI
Blacksburg, Virginia 24061

Dr. George Westbrook
Florida Dept. of Agriculture
Division of Technical Control
Winter Haven, Florida

Mr. LeRoy E. Wheatley
Delaware State Department of Agriculture
Director of Division of Production
and Promotion
Dover, Delaware 19901

Mr. Darnell M. Whitt
USDA, Soil Conservation Service
Washington, D. C. 20250

Mr. William Whyte
U.S. Dept. of Agriculture
Office of Information
Washington, D. C. 20250

Mr. Harvey Wilhelm, Director
Field Services and Quality Control
Mountain Empire Dairymen Association
945 Eleventh Street
Denver, Colorado 80204

Dr. T. L. Willrich
Agricultural Engineering
Corvallis, Oregon

Mr. Jack Witherow
Environmental Protection Agency
Water Quality Office
P.O. Box 1198
Ada, Oklahoma 74820

Mr. William Witmer
Farmers Union Grain Terminal
Association
Box 1447
Sioux Falls, South Dakota 57101

Mr. J. C. Yates
Water Resource Specialist
Office of State Engineer
State Capitol
Santa Fe, New Mexico 87501

Dr. R. G. Yeck
USDA, ARS
Plant Industry Station, Rm. 331 No. Bldg.
Beltsville, Maryland 20705

Mr. Hiram Zigler
Coordinator for Local Affairs and
National Resources
Virginia Farm Bureau Federation
200 West Grace Street
P.O. Box 27552
Richmond, Virginia 23261

Dr. H. C. Zindel
Agricultural Experiment Station
Department of Poultry Science
East Lansing, Michigan 48823